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MARCH 2004

MODEL Airplane NEWS

MODEL AIRPLANE NEWS 75th ANNIVERSARY 1929-2004

BANZAI!

THE WORLD MODELS ZERO p. 58

Giant-scale racers go for the gold!

BASICS OF 4-STROKE ENGINES WHY WE LOVE 'EM

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Top turbine trainers

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MODEL AIRPLANE NEWS 75th ANNIVERSARY 1929-2004

MODEL Airplane NEWS

MARCH 2004, VOLUME 132, NUMBER 3

FEATURES

FLIGHT TESTS

CONSTRUCTION

COLUMNS

ON THE COVER: The World Models' giant-scale Zero comes around for a pretty pass. Check out the complete review on page 58. ON THIS PAGE: Formula One racers prepare for takeoff at the Blue Water River Run in Arizona (photos by John Reid).

DEPARTMENTS

EDITORIAL

BY DEBRA CLEGHORN

The need for speed

For heart-pounding excitement, not much comes close to watching 8-foot-span, gas-guzzling behemoths tearing around pylons so fast that they blur as they pass by. RC'ers have been racing these giant models of full-size Reno Air Race warbirds since 1991, and since then, these models have evolved into seven classes of aircraft and a three-race series in which pilots accumulate points to determine an overall annual champion. This year, the adrenaline-pumping action culminated in the Blue Water River Run at Avi Sequilla Airport in Parker, AZ, where intrepid West Coast associate editor John Reid got as close to the action as he dared to capture all the fun on film. Hosted by the Unlimited Scale Racing Association (USRA), the Blue Water River Run featured high-power planes competing at speeds of more than 220mph; how's that for satisfying the speed demon inside you? For race results and an inside look at giant-scale racing, check out John's article on page 36.

If park and backyard flyers are more your speed, you won't want to miss associate editor Rick Bell's "Backyard Flyer" column this month. You'll read how he hopped up and modified a GWS Slow Stick—a favorite easy flyer—and turned it into an all-out aerobatic machine. Starting on page 96, Rick details basic changes to the flying surfaces, controls and power system. You'll be amazed by this simple, high-performance model!

In "Thinking Big," senior tech editor Gerry Yarrish offers an inside look at some giant-scale "trainers" with a twist: turbine power! If you're intrigued by the power and speed of jet aircraft, there's no better place to start than a turbine trainer. Turn to page 126 to see how easy it is to be a jet jock.

IN THE WORKSHOP

Scale planes need scale wheels, and in this issue, Keith Sparks shares a method of making lightweight, sturdy spoked wheels out of PVC pipe and monofilament line. These easy-build wheels look great and can be built to any dimensions you need.

Looking for a building project? Check out John Tanzer's WW I Sopwith Camel—a ¼-scale biplane inspired by a full-size Camel at the Rhinebeck (NY) Aerodrome. Although this model has a very scale outline, it features simplified construction techniques. John has been designing model airplanes for nearly 30 years, and we're pleased to add his latest to our plans directory.

Safe landings!

MODEL AIRPLANE NEWS 75th ANNIVERSARY 1929-2004

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TEXAN POWER

I read with great interest George Leu's review of the Hangar 9 Texan ARF in the February issue. I have been thinking about getting that plane, and his article pushed me over the edge; I already have alternative decals picked out! One question: George wrote that his model flew well with a Webra .60 2-stroke. I'd like to use my Saito .91 2-stroke, but I wonder whether it would overpower the plane. Thanks for your help, and keep up the good work; I enjoy every issue.

Joshua Freeman [email]

Joshua, your Saito .91 will be an ideal powerplant for the Texan; in fact, that model is rated for a .65 to 1.00ci 4-stroke. Although the .91 will be at the higher end of the power spectrum, you shouldn't have any trouble, and can you ever really have enough power? Good luck with your T-6. DC

HAPPY ANNIVERSARY

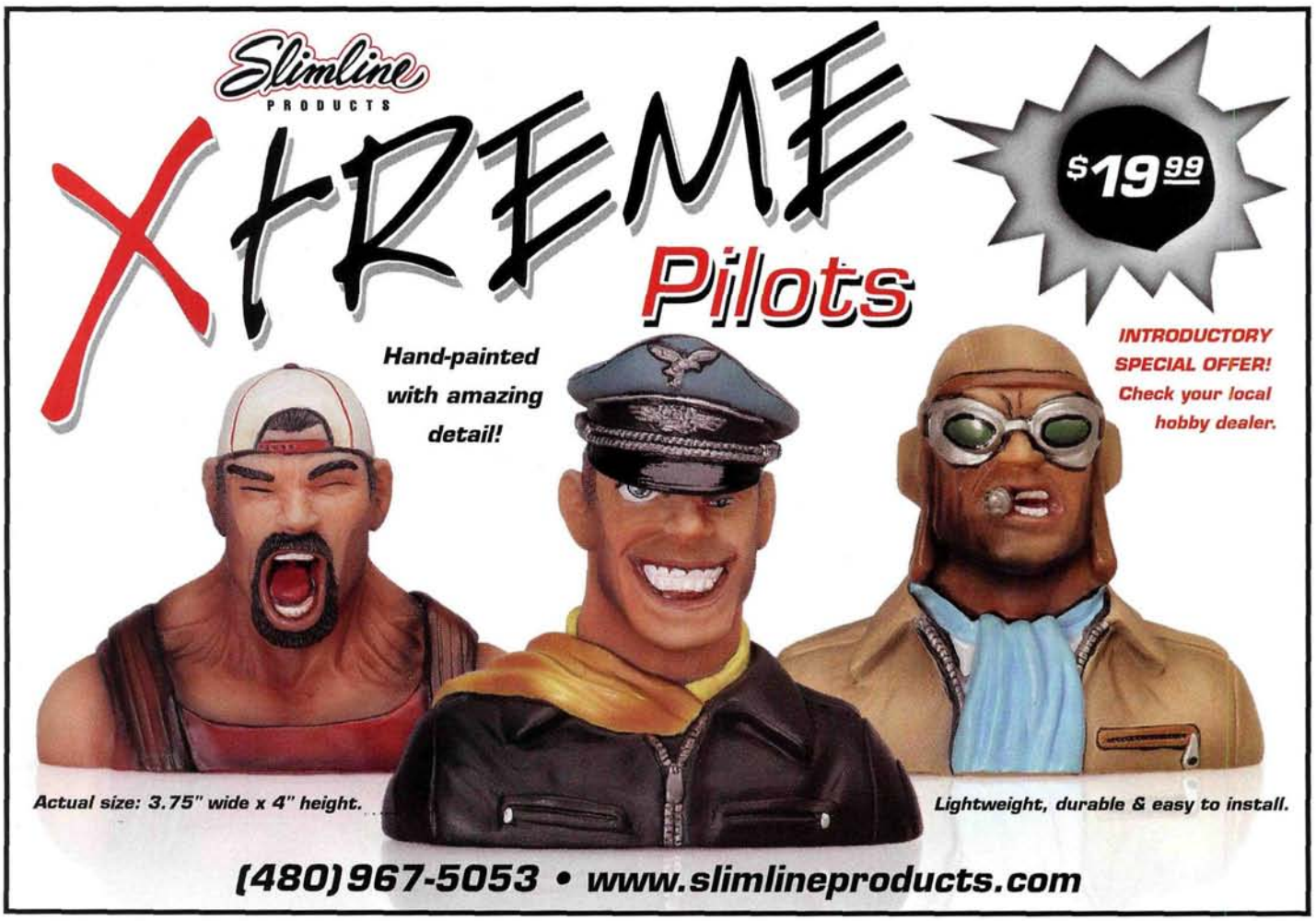
First of all, congratulations on your first 75 years. I hope to still be a subscriber for another 75 years (at the age of 120!). In the January 2004 editorial, Debra Cleghorn wrote that a lot of material from old issues of *Model Airplane News* had been reviewed for the commemorative article. Is there much more material than has been published that is stored in a computer file? I would rush to order it; it would be a graphic history of model aviation. Again, happy birthday and congratulations.

Manuel Ortiz Aguilar
Madrid, Spain

Thanks for the trip back in time. Until yesterday, I hadn't purchased a copy of *Model Airplane News* for more than 25 years. I left RC and flying scale models after the Scale Internats in Ottawa in the '70s. The growing trend toward large-scale and .60-powered, tuned-pipe pattern "bombs" was too much for me and my MG-A sports car transportation. I preferred to fly much smaller models—.19-powered and below. I even had a few photos and construction articles published in model magazines of the day, including *Model Airplane News*. Reading your current issue, it appears that my interests were more in line with the models that you feature in *Backyard Flyer*. It was fun to once again read about the exploits of some of the old gang, like Hal deBolt and Maynard Hill. It was also great to see that Nick Ziroli Sr. has hair with white waves just like mine!

Gerry Cole
Longmont, CO

Very well done on your 75th Anniversary issue! It reminded me of special issues of years past—the annuals—that I always very much looked forward to. I am celebrating a model aviation anniversary this year, too. September marked, for me, 50 years of



involvement with internal-combustion model airplane engines. (I have been a regular reader of "MAN" even longer than 50 years!) These days, my flying consists mostly of building and flying "sport" RC models.

As I mentioned at the top, I am enjoying the 75th issue very much—excellent job. Keep up the fine work.

F. Gerald Long
Pooler, GA

We're glad you appreciated our Anniversary issue; we enjoyed putting it together and hope that it brings back a lot of memories for everyone. We'll continue to highlight significant articles and issues throughout the year in our Model Airplane News *"Classics" column.*

All of our research involved thumbing through back issues and taking photos of old articles; only information for the last 10 years or so is available electronically. DC

INVERTED 4-STROKES

I've read several articles on operating 4-stroke engines inverted. The problem of hydraulic lock on starting is obvious and easily overcome. Less obvious, however, is the issue of camshaft lubrication. One gentleman wrote that cam/followers wear out after about one hour of operation.

Shay Pickton
Lafayette, CA

Shay, operating a 4-stroke engine inverted doesn't cause any more problems than running it upright. Four-strokes displace oil in the fuel from the high-pressure combustion chamber to the relatively low pressure of the crankcase. Moving past the piston compression ring, everything gets lubricated, including wristpin bosses, connecting-rod bushings, crankshaft/camshaft ball bearings, cam lobes, lifters and lifter guides—residual oil vents from the crankcase to the atmosphere. A few high-dollar 4-strokes lubricate by inducting fresh fuel and air through the crankcase prior to valving it into the combustion chamber.

Today, 4-stroke engine manufacturers and distributors realize the harm (mechanical wear) that low-percentage-oil fuels can inflict on their product; most recommend at least 20 percent. The new YS DZ 4-stroke engine requires 24 percent. RC and control-line precision aerobatic models have used inverted 4-stroke engines for years and are routinely operated for dozens of hours without problems other than the occasional necessary valve adjustment. For more information on 4-stroke operation and maintenance, see my "Basics of 4-Strokes" article in this issue.
Dave Gierke

GLOW-TO-GAS CONVERSION

In Fred Coleman's December 2003 review of the Flair Products Stearman PT-17, he references his conversion of an O.S. Engines' BGX 3500 to gasoline. The conversion used a "Pro Spark" electronic ignition. There is no mention of this product in the listing of suppliers at the end of the article. Can you please provide a source of this product or a website for additional information and possible suppliers of this product? Thanks for your help.

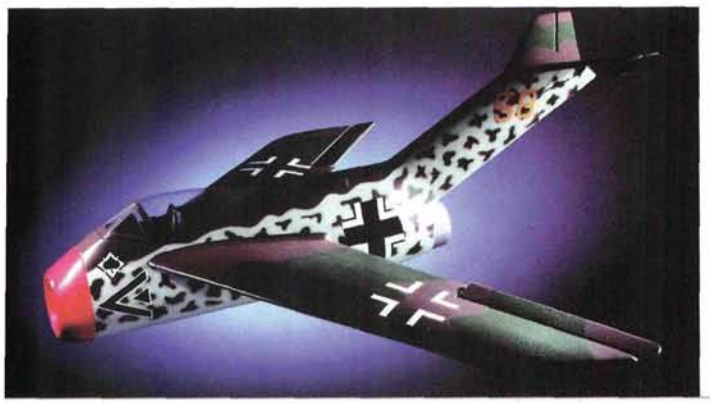
Len Ferenchak [email]

Len, you can buy that product from Nelson Hobby Specialties, toll-free (877) 263-5766 or (503) 259-8899; nelsonhobby.com. Senior tech editor Gerry Yarrish reviewed this unit in November 1999 and noted that it really works well; you don't have to do any major modifications to your engine, and you can just bolt the ignition unit right on. DC

AIR SCOOP

by the Model Airplane News *crew*

NEW PRODUCTS hit the model airplane market all the time, so here's the inside source for what's hot and where you can get it. For every issue, we sift through product announcements, show reports, rumors and prototypes to let you in on the best and the latest. Remember, you saw it here first!



ALFA MODELS
FOCKE WULF TA-183 "HUCKEBEIN"

This scale, electric, ducted-fan jet comes with a fan unit and a Speed 300 motor installed and with its molded foam fuselage and wing painted; you only need to assemble it. Install your RC gear and decide which of the German markings water-slide decals you want to add! The 31.5-inch-span, 19-ounce plane is easy to hand-launch and has aileron, elevator and motor speed control; it boasts flight times of more than 5 minutes. It costs $169.
Alfa Models; distributed by Hobby Lobby Intl.
(615) 373-1444; hobby-lobby.com.

O.S. ENGINES
.46 AX BB ENGINE

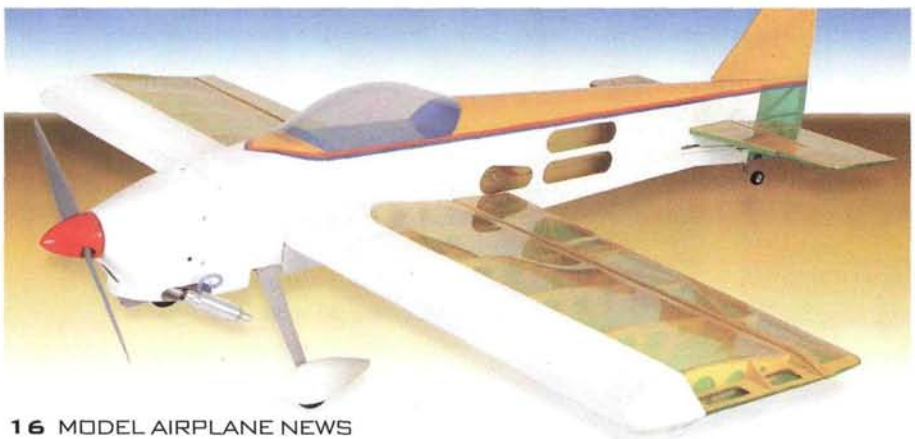
This latest engine from O.S. has all the power and high-quality components that have made the high-performance FX line so popular and adds some advances of its own! The .46 AX's internal design modifications include changes to the liner port, a better-balanced crankshaft, ball milling of the inlet port and a machined piston. The carb needle can be positioned horizontally or vertically, so it's easier to adjust and more stable. The box-design muffler features an innovative silencer with improved capacity and efficiency for reducing baffle. It also comes with an A3 glow plug. Specs: displacement—0.455ci; bore—0.866 in.; stroke—0.772 in.; output—1.65 bhp @ 16,000 rpm; practical rpm range—2,000 to 17,000; weight—13.2 oz.; suggested propeller sizes—10.5x6, 11x6-8, 12x6-7. The new .46 AX and muffler will cost $199.99.
O.S.; distributed by Great Planes Model Distributors (217) 398-6300; (800) 682-8948; osengines.com.

JR
XP6102

If you want the features of a flagship radio but don't need the confusion of 8 or more channels, you're in luck! Six-channel simplicity and high-end programming are combined in this latest radio from the folks at JR. With a clutter-free display screen and graphical representation of dual rates and exponential, the XP6102 makes it easy to program. This new radio has all the features you would expect and more, including 10-model memory, 8-character model naming, digital trims, selectable switch locations, sub-trim and travel adjustment, dual rates and exponential on aileron, elevon and rudder, four programmable mixes ... the list goes on and on. The FM air and heli versions cost $349.99 and $399.99 respectively; the PCM air and heli versions cost $389.99 and $439.99.
JR; distributed by Horizon Hobby Inc.
(800) 338-4639; horizonhobby.com.

SPORTSMAN AVIATION
Paramount 52/70 ARF

This advanced aerobat offers 3D tournament-style performance! A smaller version of the popular Paramount 61, it has a thick, built-up symmetrical wing and extra-large ailerons for razor-sharp roll control. Aerodynamically balanced, oversize split elevators and a huge, full-flying rudder provide the control authority to perform the wildest maneuvers you can think of, and the Paramount's high-profile fuselage allows it to fly knife-edge at low speeds. The model comes with a fiberglass cowl, landing gear and wheels and pull-pull rudder cables. Specs: wingspan—50.75 in.; wing area—685 sq. in.; length—53 in.; weight—5 to 5.75 lb. It requires a 4-channel radio with five servos and a .46 to .52 2-stroke or .70 4-stroke. The Paramount costs $189.99.
Sportsman Aviation; distributed by Global Hobby Distributors (800) 854-8471; (714) 963-0133; globalhobby.com.



FUTABA
S9152 & S9153 digital servos

Looking for big muscle with less heat? Both of these high-torque servos feature an innovative aluminum case that acts as a heat sink and reduces inside temperatures by as much as 30 degrees compared with servos with molded plastic cases. The sophisticated microprocessor technology inside these digital servos means a cleaner, clearer signal for smoother, sharper response. Each servo measures 1.9x1.6x1 inches and weighs 2.6 ounces. The S9152 digital rudder servo produces 277.6 oz.-in. of torque and can move 60 degrees in 0.19 second (at 6 volts); the S9153 digital aileron/elevator servo produces 222 oz.-in. of torque and can move 60 degrees in 0.16 second. Each will retail for $149.99.
Futaba Corp. of America; distributed by Great Planes Model Distributors (217) 398-6300; (800) 682-8948; futaba-rc.com.

MRC
Toki Micro Turbine

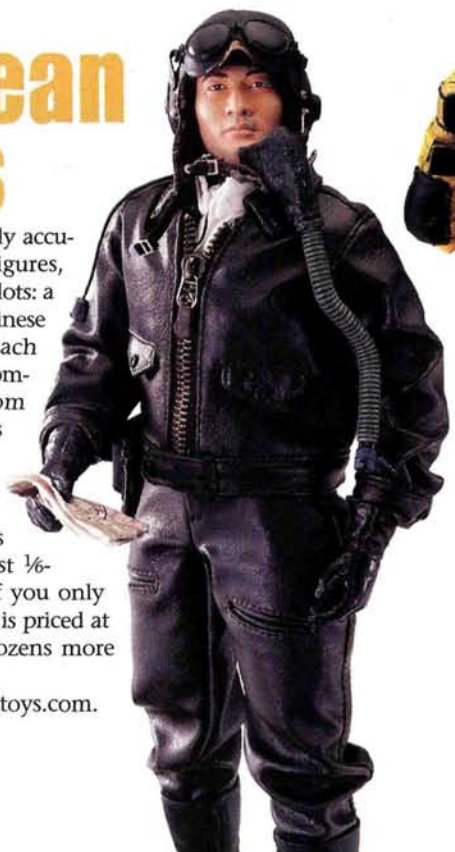
Our spies always seem to come up with the neatest stuff in the RC industry, and this one ranks up there with the best of them. Still under development, this Toki micro-turbine engine will be available from MRC in a few years. Its outside diameter is only 2⅛ inches, and it has an overall length of only 8⅝ inches, including the forward starter housing and the tailpipe. The engine weighs in at 450 grams (1 pound!). The Toki is predicted to produce about 4½ pounds of thrust. Imagine the great miniature jet models that could be designed around this impressive little power unit! We'll keep you up to date as things come together.
MRC (732) 225-2100; modelrectifier.com.

ICARE SAILPLANES
Osiris DLG ARF

With this all-molded, discus-launch glider, you can achieve spectacular hand launches that propel the plane 100 feet and higher! Because it's so highly prefabricated, you hardly need to spend any time at all to get it in the air. The 59-inch-span, hollow molded wing is completely finished and ready to receive two sub-microservos for the ailerons. On the tail, only the rudder must be glued into place. The fuselage even comes with the pushrods installed. A small hardware package and instructions complete the kit.
ICARE Sailplanes (450) 449-9094; icare-rc.com.

BBI
U-2 & Korean War Pilots

The folks at bbi, who make the historically accurate Elite Forces Aviator Series action figures, now offer three new incredibly detailed pilots: a North American F-86 Sabre Jet pilot, a Chinese MiG pilot and a Lockheed U-2 pilot. Each comes with an authentic uniform that's complete with accessories—everything from headsets and oxygen masks to weapons and parachute harnesses. The U-2 pilot even comes with a tiny replica Sharpie pen because that was part of the real pilots' official gear! These figures are ideal as full-body pilots in your latest ⅙-scale model, but we won't blame you if you only want to put them on display. Each figure is priced at $39.99; check out the bbi website for dozens more of these authentic pilot figures.
bbi; a division of Blue Box Toys; blueboxtoys.com.



CARL GOLDBERG MODELS
Sukhoi 1.20 ARF

This quick-building replica of the Russian aerobat offers a lot of scale detail and superb aerodynamics; large, double-beveled control surfaces and pull-pull rudder control come together to deliver exhilarating performance. The lightweight, jig-built airframe, built-up wings and airfoil stab are all wood, and a fiberglass cowl, motor mount and painted aluminum landing gear add style without extra work. A generous hardware package is also included. Specifications: wingspan—72.5 in.; wing area—949 sq. in.; weight—9 to 10 lb.; length—65 in. Requires a .60 to .90 2-stroke or .90 to 1.20 4-stroke and 4-channel radio with six servos. The Sukhoi costs $649.99.

Carl Goldberg Products Ltd.; distributed by Great Planes Model Distributors (217) 398-6300; (800) 682-8948; greatplanes.com.

GIANTSCALEPLANES.COM
CESSNA SKYLANE

Designed to impress, this 63-inch-span Cessna ARF is for intermediate and advanced pilots. The model features a painted fiberglass fuselage, cowl and wheel pants and sheeted-foam wings that are covered to match. It also comes with decals and with installed control-horn mounts as well as landing gear and hardware. You'll need a .40 to .46 2-stroke or .52 to .63 4-stroke and 4-channel radio with five servos.

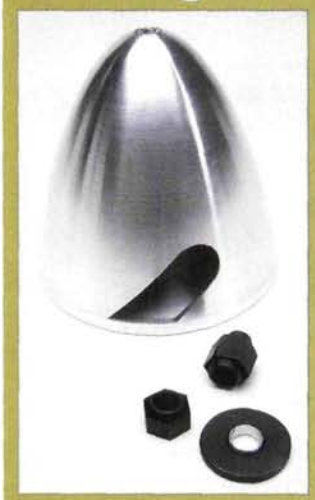
GiantScalePlanes.com (610) 282-4811; giantscaleplanes.com.

THE WORLD MODELS
Velox Rev II

Sport fliers take note: this new 65-inch-span ARF from The World Models is ideal for intermediate and advanced fliers and offers high-quality construction and hardware. The Velox Rev II features balsa and ply construction, iron-on covering, carbon-fiber landing gear, an anti-vibration engine mount and a plastic spinner with an aluminum backplate. A painted fiberglass cowl and wheel pants enhance this plane's good looks. The Velox Rev II requires a .61 2-stroke or .70 to .91 4-stroke and a 4-channel radio with five servos.

The World Models Mfg. Co. Ltd.; distributed in the USA by AirBorne Models (925) 371-0922; airborne-models.com; theworldmodels.com.

TRU-TURN
Hangar 9 Mustang Spinners



Everyone loves a Mustang, and the popular Hangar 9 P-51 ARFs have gotten the attention of those talented folks at Tru-Turn Precision Model Products. The latest additions to Tru-Turn's line of P-51-style spinners are a perfect fit for the Hangar 9 1.20- and 1.50-size models. The 3½-inch spinner comes slotted to fit most props used on 1.20 to 1.80 4-stroke engines. The slot pattern is ideal for 2-blade APC props that range from 15x8 up to 17x10 and can be specially ordered to fit others—including 3- and 4-blade props! They cost $60. The larger, 5-inch-diameter spinner costs $160; it's also available in 2-, 3- and 4-blade styles!

Tru-Turn Precision Model Products; distributed by Romco Mfg. (281) 479-9600; tru-turn.com.

SIG MFG.
SYN PLUS

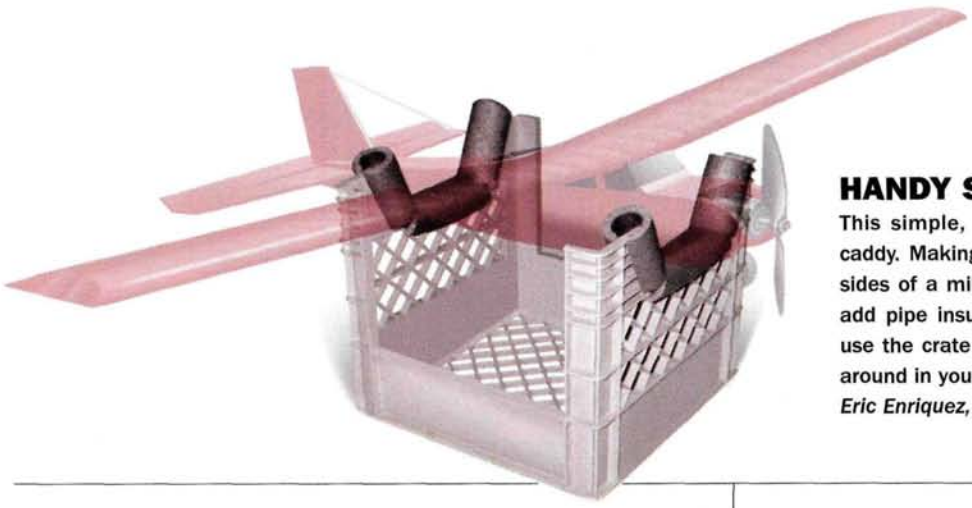
This revolutionary new fuel for 2-stroke model airplane engines is specially formulated to burn cleanly and offer superior engine protection. Blended with pure methanol, 99-percent-pure nitromethane and Klotz synthetic racing lubricant, Syn Plus delivers maximum power with minimal exhaust residue. The "plus" is a special engine additive called "SG-7" that is blended into every gallon of Syn Plus glow fuel. SG-7 effectively reduces the engine's internal working temperature without causing any loss of power or performance. This heat reduction keeps your engine running more smoothly and cooler than you would have ever thought possible. Lower engine temps help your engine run more efficiently and mimimize wear and tear. Syn Plus is available in 5-, 10- and 15-percent-nitromethane blends from your local hobby retailer or direct from Sig and costs $16.99, $19.99 and $23.99, respectively.

Sig Mfg. Co. Inc. 641-623-5154; sigmfg.com.

TIPS & TRICKS

Illustrations by Richard Thompson

SEND IN YOUR IDEAS. *Model Airplane News* will give a free, one-year subscription (or a one-year renewal, if you already subscribe) for each idea used in "Tips & Tricks." Send a rough sketch to *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA. BE SURE THAT YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can neither acknowledge each one nor return unused material.



HANDY STAND

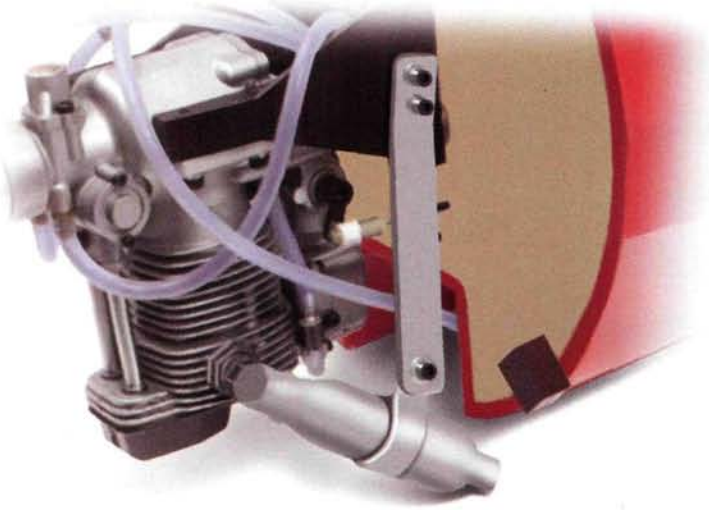
This simple, inexpensive airplane stand doubles as a tool caddy. Making it couldn't be easier: just cut out the opposite sides of a milk crate so it will cradle a mid-size fuselage and add pipe insulation for padding. The best part: you can also use the crate to carry your fuel, starter, etc., so they don't roll around in your car's trunk on the way to the field.

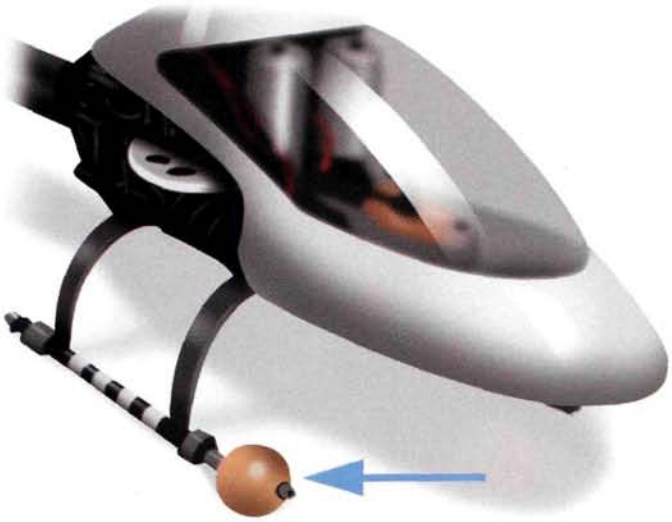
Eric Enriquez, Pensacola, FL

MUFFLER HOLD-DOWN

To minimize the chance of engine vibration loosening a screw-on muffler, make and install this simple bracket. First, drill two holes about ¼ inch apart on the engine mount and between the two firewall mounting screws; next, drill two matching holes in a flat aluminum strip. Drill another hole at the end of the strip. Attach the strip to the mount with two hex-head screws and then attach the other end of the strip to a round bracket with another hex-head screw. This bracket fits around the muffler and holds it securely to prevent engine vibration from working it loose in flight. By attaching the strip to the mount instead of to the firewall or another part of the airframe, you'll ensure that both ends of the bracket move together as the engine vibrates.

Jerry Smith, Acworth, GA





KEEP YOUR EYE ON THE BALL

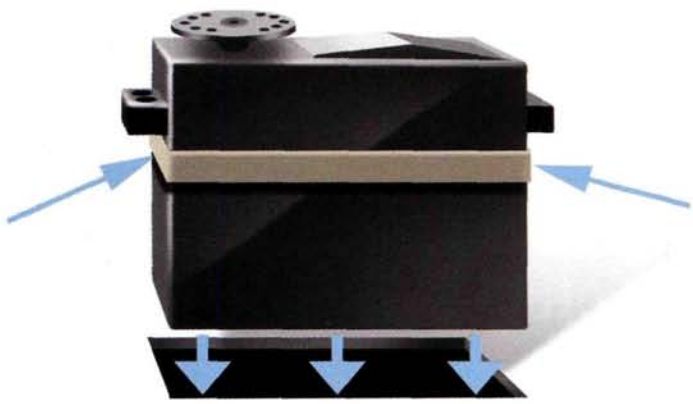
Here's a great way to be sure of the direction your helicopter is facing. After you've graduated from using helicopter training gear, pull one of the balls off the training gear, drill it out and mount it on one skid. This will significantly reduce orientation confusion when your helicopter is far away from you. Because the ball is so light, it shouldn't affect your heli's center of gravity.

Jim Miller, Salt Lake City, UT

SERVO-MOUNTING AID

When you install a servo, it can be difficult to maintain a uniform clearance around it while you mark the positions of the mounting holes. If you place a rubber band around the servo just below the mounting lugs, you'll be able to maintain the correct spacing between the servo and the plywood tray. Be sure to take the rubber band off before you install the servo permanently!

Albert Niessner Jr., State College, PA



PILOT PROJECTS

SEND IN YOUR SNAPSHOTS. *Model Airplane News* is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable, but please do not send digital printouts or Polaroid prints. Emailed submissions must be at least 300dpi. We receive so many photographs that we are unable to return them. All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of the year. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in! Send those pictures to "Pilot Projects," *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

PT-19

Tony Kameen, Moreno Valley, CA

Tony has long collected Jim Meister's JEMCO line of sport-scale kits but had never found a JEMCO PT-19 until he opened an unmarked box at a swap meet and discovered one inside. With just a set of plans and an incomplete fuselage, Tony got to work. He says, "The fuse was pretty old and yellowed but had been built by an excellent modeler. I used the plans to produce the wing and the rest of the balsa parts and the cowl, all of which were missing." He finished the plane with silkspan and dope and used Tamiya plastic paint for the colors and insignia. The completed PT-19 has a 52-inch wingspan, and it's powered by an O.S. LA .40 engine. An Airtronics radio controls all the usual surfaces—plus flaps. Great job, Tony; good thing you peeked inside that box!

FOKKER DR.1

George Wendt, Millbrook, AL

This is the third triplane that George has built, and it looks as though it proves the adage that "The third time's a charm." George tells us that he really enjoyed building this beauty from Balsa USA; it weighs 16 pounds and is powered by a Zenoah G-26 engine, covered with Sig Coverall and painted with Krylon. According to George, "The kit was a blast to build! The parts fit was great, and the plans were well thought out."

KIT-BASHED T-34

James Williams, Santee, CA

Jim's latest building project started out as a Sig Astro Hog, but he changed it to resemble a T-34. It's powered by a Magnum .80 4-stroke—"... a perfect engine for it," according to Jim—and uses an Airtronics Vanguard 6-channel radio. He says that the plane's flaps make landings very slow and smooth, and with its good looks and excellent flight characteristics, it's a real winner.

1/5-SCALE TACHIKAWA KI-55

James Biza, St. Paul, MN

As a winter project, James scratch-built this model of the Ki-55 "Ida" version—a WW II Japanese trainer—from Dave Anderson plans. It has full flaps and an 84-inch wingspan, and it's powered by an O.S. 1.20 4-stroke Surpass engine. Weighing in at 11 pounds, the "Ida" is finished in MonoKote and sprayed with flat, clear LustreKote. Nicely done!

CHRISTEN EAGLE

Brett Hankins, Roseville, CA

Built from an old Byron Originals kit, Brett's Christen Eagle has a 68-inch wingspan and weighs 17 pounds. It's powered by an RCS 44cc twin turning a 20x10 Zinger prop, and this combo "... makes for good—a little better than scale—performance," according to Brett. The plane is controlled by Futaba radio gear, and it's set up with a fiber-optic ignition kill switch that's operated by an auxiliary channel on the radio. Adds Brett, "This works very nicely and is a good safety feature. The plane flies very well; you do, however, have to be on your toes!"

¼-SCALE SOPWITH PUP

Ted Kulik, Groveland, MA

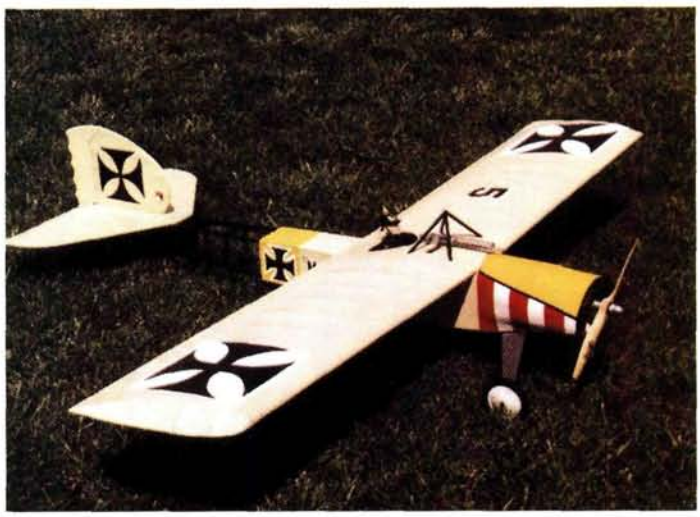
This Balsa USA bipe is covered with Solartex and material from a 4-inch aluminum dryer-vent pipe. The 77-inch-wingspan plane is 53 inches long and weighs about 16½ pounds. The machine gun and wheels are from Williams Bros.; the rigging wire and turnbuckles are from Proctor Enterprises; and the engine is a Saito FA170R3 spinning a Master Airscrew Classic Series 18x6 prop. The Pup's transmitter and throttle servo are from Futaba, and the 3-cylinder glow drive is by Aero Electronics. "This is a great kit to build and fly," Ted says.

SCRATCH-BUILT ELDER

Jim Wahner

Milwaukee, WI

A takeoff on the Fokker Eindecker, Jim's scratch-built "Elder" has an O.S. .52 4-stroke engine up front, and he says that the plane flies great—very slow and predictable. It shows up well in the sky, and its pilot figure is a true German warrior complete with a "pickle," or pick (spike) on top of his helmet. "It's a fun, laid-back airplane," Jim's letter concludes.



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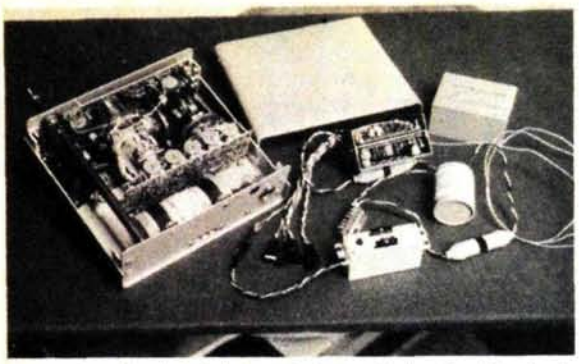
B.B. Weber, Houston, TX
B.B.'s gorgeous rendition of a KLM "Connie" was scratch-built from Don Smith plans. "The Flying Dutchman" has a 132-inch wingspan and a 122-inch-long fuselage, and the aircraft weighs 52 pounds. It's powered by four O.S. .91 FS 4-stroke engines and has an all-Futaba radio system, Robart retracts, wheels and brakes by Charlie Stevens, Tru-Turn spinners and 3-blade, 14x7 props from Graupner. B.B. says, "It flies perfectly," and we believe it.

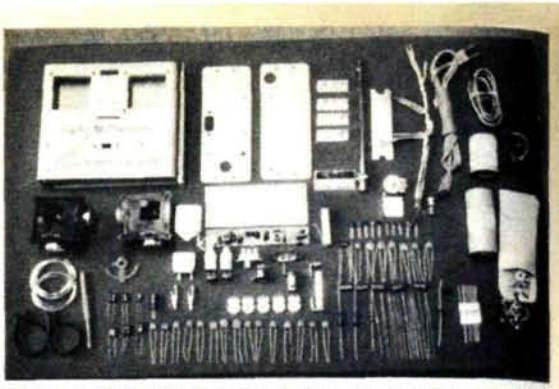
AT-6
Rick Apitz
New Ulm, MN
Brandt Jasper's AT-6, powered by a Fox 4.2 engine, makes a smoking flyby at the Rainy River International Fun Fly in Rainy River, Ontario, Canada. Rick Apitz submitted this beautiful portrait of the aircraft.

HEATHKIT DIGITAL 5

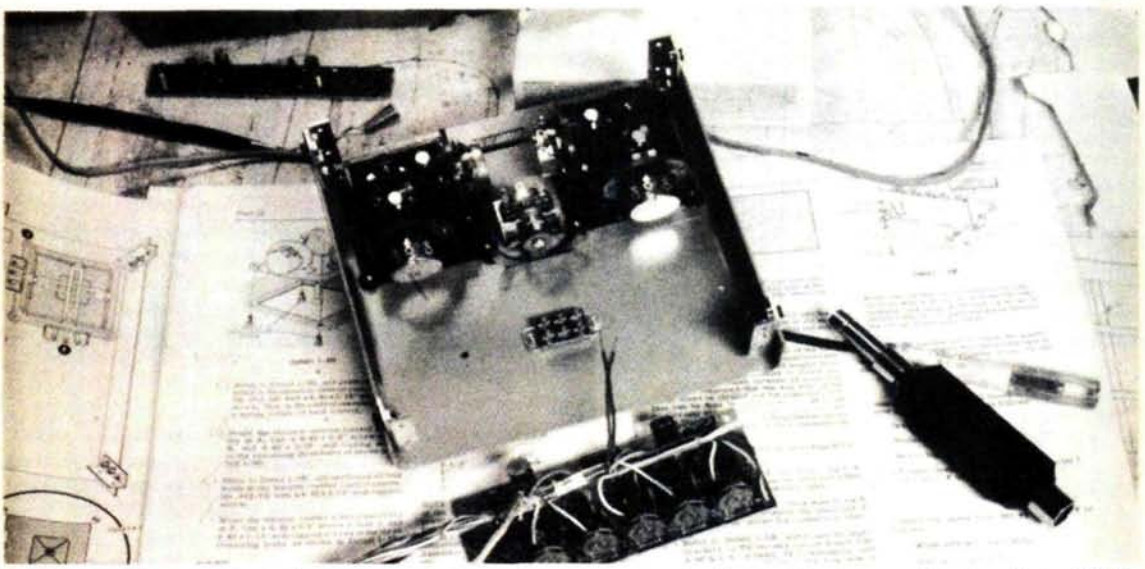
Today, few serious pilots would even consider using anything but a digital proportional radio, but when this review of the Heathkit Digital 5 appeared in the July 1968 issue of *Model Airplane News*, such technology represented the wave of the future. Managing editor Bill Northrop, with the help of a 124-page instruction booklet, built the Heathkit Digital 5 kit for this "Field & Bench." It was the very first digital proportional radio review to appear in the pages of *Model Airplane News*. Bill stated that there was no need to know what was going on electronically as long as you followed the directions; just put the parts in place and solder them together. Bill assembled the transmitter in 4½ hours, and it was ready to test and adjust; 6½ hours were needed for the receiver, and the servo kit (a "Potless" Kraft KPS-9) took a mere 2½ hours. The price for the radio kit was $219.95. You could buy the many components one at a time, or you could use Heathkit's payment plan and pay $20 per month. We've come a long way, baby!



Here we have the whole ball-of-wax in its completed and working form! Note how the transmitter antenna retracts completely within the case.



Transmitter kit. Directly in center of photo, you can see completed R.F. section which eliminates the need of technician checking and approving.



Transmitter partially assembled. Encoder in foreground, harness for tuning pots and stick assemblies is prepared and ready for installation.

FIELD AND BENCH

DO (SOME OF) IT YOURSELF PROPORTIONAL

By BILL NORTHROP

► Boy, talk about being mortified! Here I am, the grand and exhalted R/C Editor of M.A.N., fortunate enough to have received one of the first production kits for a Heath digital proportional, and what happens? After having built the transmitter, the receiver, and one servo (deadline time approaching), and after having tested and adjusted the transmitter, I ran into a stone wall when the receiver, although it idled properly, would not accept a signal from the transmitter. Did Heath goof? Did I goof? Was there a bad component?

Of course, there has been one BIG question, one that many people have been asking ever since the well known electronic kit manufacturer of Benton Harbor, Michigan first announced that it would produce a digital proportional radio control set in kit form. Could the average model building hacker, who is a modeler first and a radio fiddler second, by desire or necessity, put together such an exotic hunk of modern electronic achievement and make it work? Particularly, could he do it without the use of expensive test equipment that costs much more than the radio itself?

Before going any further, we'd better ease your apprehension and get the Heath boys to lower their shotguns by explaining that the "stone wall" turned out to be somewhat of a freak and the blame is shared equally between us. The first step in assembling the receiver printed circuit board is the installation of three short jumper wires on the component side. Following shortly after this, several transistors are installed and one of them happens to straddle one of those pieces of insulated, stranded hookup wire. The instructions specify that the transistors are to be positioned

USRA Blue Water River Run

BY JOHN REID

GIANT-SCALE RACERS GO FOR THE GOLD!

Jose Macias' Aerosport AT-6 comes in for a landing at the Blue Water air race.

Bernie Oldenberg prepares to launch Chris Justus' KT Aviation/Mong biplane racer.

Pete Bergstrom's Rankin/Proudbird F-1 GT racer, staged & awaiting the next heat race.

"Let's start 'em up!"

At that announcement by the flightline director, the pilots on the flightline explode into action, scurrying with their callers to their assigned areas. To counteract the forward surge that occurs when the giant engines are started, flight crews prepare to hold back the planes. As the heavy starters hit the spinners, the gas-powered engines spark into life, throwing up a wall of sound and a blast of air. One by one, the planes are released into the sky, and their pilots jockey for the perfect position to cross the starting line when the timer reaches zero.

This is how heat after heat started at the fourth annual Blue Water River Run held at the Avi Sequilla Airport in Parker, AZ, last October. It was the culmination of the 2003 Unlimited Scale Racing Association's (USRA) Championship Series—a three-race series that began in June.

The venue was one of the finest facilities I have ever seen; it was perfect for this race. Pilots came from all over the country to compete, and it showed in the number of entrants: 63 in six classes. This was the highest turnout in quite a while and was due, in part, to fantastic support by the sponsors, who reduced the racing fee to about half that of previous years. Of course, a first-class racing series would not have been possible without the commitment and expertise of the race promoters, Denny and Barbara Baker.

Approximately 40 dedicated volunteers worked behind the scenes under the leadership and direction of contest director Cal Orr. They did an outstanding job of keeping everything running on time throughout the four-day event. Each day began with a pilots' briefing at which pilots and workers could discuss any concerns; understandably, the safety of spectators and fliers was always the hot topic at these meetings. Action resumed after the briefing, and the event proceeded throughout the day, heat after heat without a hitch.

Mel Santmeyer's KT Aviation/Mong takes to the sky.

Spectators check out the QuickTurn/GR7 that Mark Zeal raced in the new F-1 GT class.

SPEED + LEFT TURNS = EXCITEMENT!

As with all USRA events, several classes of races were held, including AT-6, Dominator, Biplane, Formula One, Formula One GT, Experimental and Unlimited. All of the classes were fun and exciting for me, but I most enjoyed the Formula One GT, Dominator and AT-6; in these groups, everyone competes on the same level by using stock engines and planes (up to a point); the fuel and props are supplied by the organization. Piloting skills determine the outcome of the race. For example, during a Formula One GT race, all five of the planes crossed the starting line together, and they stayed that way during all six laps! Each turn produced a new leader; part of the crowd cheered as the others groaned. On the next turn, the other side would cheer. This continued for all six laps, with no sure winner until the finish line was crossed!

If you are looking for sheer speed and power, the Formula One, Experimental and Unlimited classes will really get your adrenaline going. These monsters tear up the course at speeds approaching 220mph, and when everything really comes together, faster than that on a lap or two. How fast do these 100-inch-wingspan planes travel? Well, keep in mind that the pylons are set 1,600 feet apart (equivalent to five-plus football fields), and laps under 14 seconds were not at all uncommon. That translates to the planes covering 10½ football fields in less than 14 seconds (and remember—they have to slow down for two turns)!

Below: Scott Hanbury's Rankin/Polecat takes the low line past Tim Redelman's QuickTurn/GR7 (above) in an exciting F-1 GT heat race.

SUPPORT

Events like this would be impossible without the generous support of many sponsors. At this contest, a few sponsors went above and beyond by providing extraordinary support. Horizon Hobby, a key series sponsor, kicked in more than $5,000 in merchandise from Zenoah and JR for this race alone. A special mention goes to the Blue Water Resort and Casino for its outstanding support, as well; its management covered most of the expenses of the local helpers and donated $5,000 in prize money, too! As a sponsor of the F-1 class at all three series events, California Research Tabulations (CRT) contributed $3,000. The total payout of prize money was $8,850, along with more than $5,000 in merchandise, for a grand total of over $14,000 in cash and prizes. Thanks to everyone for their generosity and commitment to making this a memorable racing series.

First-time fliers

To entice new fliers to the sport of unlimited scale racing, the USRA started a new entry-level class: Formula GT. It's the perfect way for new pilots to join the exciting world of pylon racing! The GT class expanded from seven to 14 entrants in only three races, and more growth is expected next year. In this class, participants fly some of the most stable planes available, with the added simplicity of fixed landing gear and stock engines.

Formula One GT participants use the same planes as Formula One fliers, except that GT participants must run stock Zenoah GT-80 gas engines. To ensure that everyone runs a stock engine, the planes are impounded after the race, disassembled by a qualified mechanic and examined for any modifications. Organizers of the event supply stock props and gas. Planes that might run in the GT class include the GR-7, Cosmic Wind, Polecat, Kelly and Nemesis.

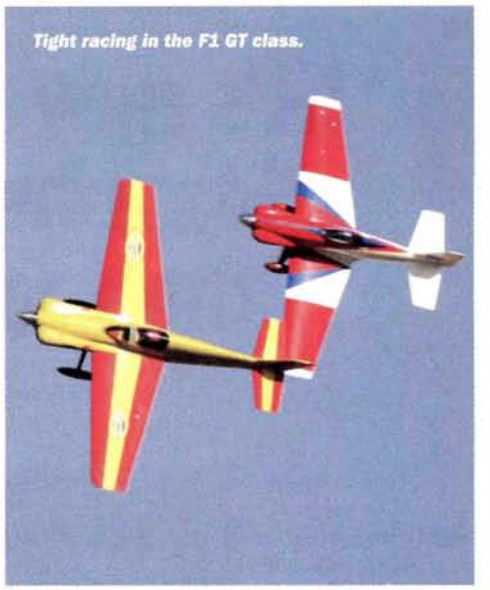
This is a perfect way to start your racing career because Formula One planes don't require a complicated retractable landing-gear setup, and they are generally simple to construct and assemble. The best part is that you don't have to be an engineer to run a stock engine; usually, you can set it once and leave it alone. The biggest advantage to starting in this class—as opposed to the AT-6 or Dominator class—is that you can move up to the world of advanced competitive Formula One racing just by modifying the engine. The planes are the same in both classes. When you're ready to move on in your racing career, it's a simple step up. The next racing season starts in the spring, so start building now and you'll be able to compete by then!

Blue Water River Run Trophy Race Winners

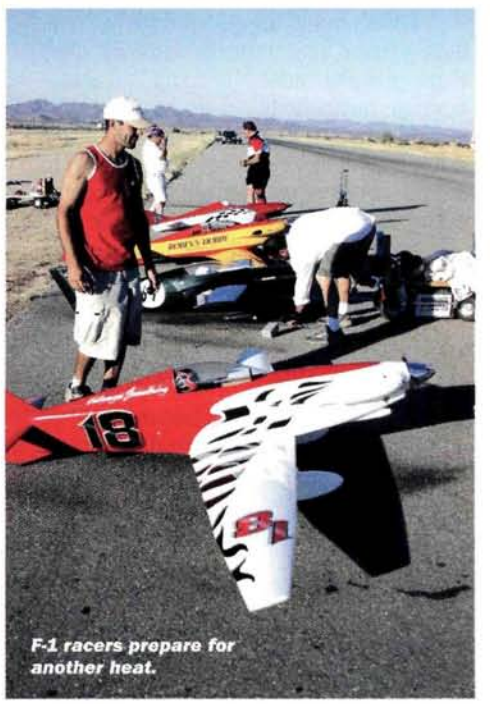
PLACE	TAIL NO.	NAME	OFFICIAL TIME	PLANE	ENGINE	RADIO
DOMINATOR						
1	29	John Lockwood	2:06.32	Lanier/Dominator 1500	Moki 2.10	JR
2	17	Ralph Braun	2:13.13	Lanier/Dominator 1500	Moki 2.10	JR
3	13	Ben Hinkle II	2:15.15	Lanier/Dominator 1500	Moki 2.10	JR
4	22	Tim Sparks	2:30.28	Lanier/Dominator 1500	Moki 2.10	Airtronics
5	34	Dean Cranston	2:23.15	Lanier/Dominator 1500	Moki 2.10	JR
FORMULA ONE GT						
1	94	Diego Lopez	1:50.40	Extra/KellyF1-D	Zenoah GT-80	Futaba
2	98	Peter Goldsmith	1:51.85	Rankin/Proudbird	Zenoah GT-80	JR
3	4	Don Moden	2:01.11	Rankin/Proudbird	Zenoah GT-80	JR
4	1	Pete Bergstrom	2:08.30	Rankin/Proudbird	Zenoah GT-80	JR
5	74	Tony Husak	2:39.32	Rankin/Proudbird	Zenoah GT-80	JR
BIPLANE						
1	79	John Westbrook	2:19.25	Knight Twister	Zenoah GT-80	JR
AT-6						
1	91	Archie Snider	1:45.97*	Aerosport AT-6	Zenoah G-62	JR
2	8	Scott Hanbury	1:49.91	Aerosport AT-6	Zenoah G-62	JR
3	17	Jose Macias	1:57.24	Aerosport AT-6	Zenoah G-62	JR
4	6	Keith Keoppel	2:00.32	Aerosport AT-6	Zenoah G-62	JR
FORMULA ONE GOLD RACE						
1	8	Ken McSpadden	1:27.24	QuickTurn/GR7	Zenoah Z-445	JR
2	17	Fred French	1:30.96	QuickTurn/GR7	Zenoah GT-80	JR
3	10	Jeff Powell	1:34.67	QuickTurn/GR7	Zenoah GT-80	Airtronics
4	11	Shawn Everson	1:41.71	RnR/Polecat	Zenoah GT-80	JR
5	76	Fred Sargent	DNF	QuickTurn/GR7	Zenoah GT-80	JR
FORMULA ONE SILVER RACE						
1	41	Scott Manning	1:32.41	BS Racing/Polecat	Zenoah GT-80	Futaba
2	29	John Lockwood	1:41.84	Rankin/Proudbird	Zenoah GT-80	JR
3	39	John Creagh	1:48.13	QuickTurn/GR7	Zenoah GT-80	JR
4	65	Brian Cragnotti	DNF	QuickTurn/GR7	Zenoah GT-80	JR
UNLIMITED						
1	99	Dave Smith	1:20.48	QuickTurn/Miss Ashley II	Herbrandson 280	Futaba
2	4	Joe Reichlin	1:24.23	QuickTurn/Miss Ashley II	Aerrow 200	JR
3	6	Keith Keoppel	1:25.03	AeroSport/NA-50	Aerrow 200	JR
4	91	Archie Snider	DNF	AeroSport/NA-50	A3 11.4ci	JR
5	77	Jay Replogle	DNF	RnR/Bearcat	Herbrandson 280	JR
EXPERIMENTAL						
1	47	Fred Sattler	1:17.34	RnR/Lancair IV	A3 8.8ci	JR
2	68	Tim Redelman	1:26.87	RnR/Lancair IV	Aerrow 200	JR
3	12	Daniel Goldberg	1:40.54	Rankin/Polen Special	Aerrow 200	JR
4	9	Doug Killebrew	1:43.03	RnR/Lancair IV	Herbrandson 206	JR

* A world record

Jose Macias' Zenoah G-62-powered Aerosport AT-6 on approach.


Tight racing in the F1 GT class.


Tim Redelman's Braun Racing GR7 gets airborne.



F-1 racers prepare for another heat.

Biplane Gold Race winner John Westbrook's Knight Twister.

Racing classes

ENTRY-LEVEL

DOMINATOR

The only plane used in this class is a Lanier RC Dominator 1500 with a minimum weight of 13 pounds 12 ounces. As for the engine, you may use only a stock SuperTigre 3250 or a Moki 2.10 without a tuned pipe. The race organizers will provide the gas and the propeller, and the plane will be inspected at the end of the race for any violations. Speed range: 75 to 90mph

AT-6

The plane must be a scale representation of a North American AT-6 Texan. It must have a pilot and an instrument panel in the cockpit and must weigh at least 25 pounds and have a minimum wing area of 1,500 square inches. The engine must be a stock Zenoah G-62, and it cannot have a tuned pipe. Event organizers will provide the gas and the prop, and the plane will be inspected at the end of the race for any violations. Speed range: 100 to 135mph

FORMULA ONE GT

The plane must be a 42-percent-scale representation of a Formula One aircraft that has qualified at the Cleveland National Air Races or the Reno National Air Races. The plane's minimum weight is 27 pounds; minimum wing area is 1,675 square inches. It must run a stock GT-80 without a tuned pipe and have fixed wheel pants and landing gear. The event will provide the gas and the prop, and the plane will be inspected at the end of the race for any violations. Speed range: 110 to 150mph

ADVANCED

BIPLANE

The plane must be a scale representation of a biplane on the USRA's biplane list. The minimum weight is 20 pounds with a minimum wing area of 1,460 square inches (both wings combined). The maximum 4.9ci engine must be enclosed in the cowl, and tuned pipes are not allowed. Speed range: 110 to 150mph

FORMULA ONE

The plane is a 42-percent-scale representation of a Formula One aircraft that qualified at the Cleveland National Air Races or the Reno National Air Races. The plane's minimum weight is 25 pounds, with a minimum wing area of 1,675 square inches. The maximum engine size is 4.9ci, and a tuned pipe is not allowed. Fixed wheel pants and landing gears are required. Speed range: 130 to 180mph

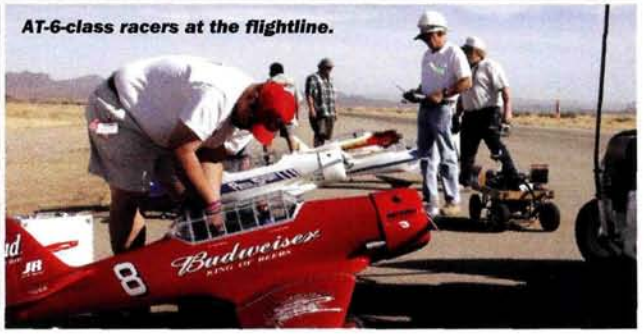
EXPERT

UNLIMITED

The plane must be a scale representation of a full-size aircraft that qualified at the Reno National Air Races. The plane's minimum weight is 25 pounds; minimum wingspan is 100 inches. Engine displacement is unlimited, maximum engine weight is 14 pounds, and the landing gear must be scale-like. Speed range: 150 to 210mph+

EXPERIMENTAL

This must be a scale representation of a full-size aircraft that qualified at the Reno National Air Races. The plane's minimum weight must be 25 pounds, with a minimum wingspan of 100 inches. Engine displacement is unlimited, maximum engine size is 217cc, and no more than 50 percent of the engine head can be exposed. Speed range: 150 to 220mph+

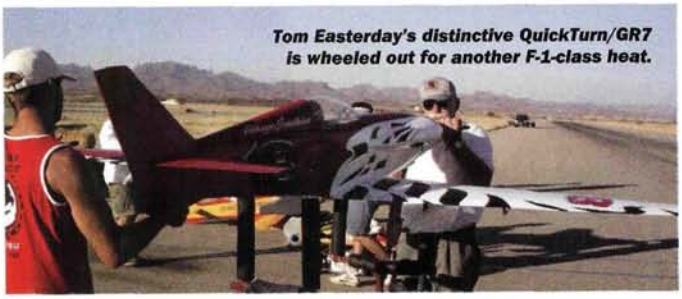


AT-6-class racers at the flightline.

Terry Williams' Polecat takes off while other F-1-class racers prepare to launch.

Jeff Powell's QuickTurn/GR7 catches a little wind on takeoff.

Scott Hanbury's handsome Aerosport AT-6 shows off its scale lines during takeoff.



Tom Easterday's distinctive QuickTurn/GR7 is wheeled out for another F-1-class heat.

F-1 GT racers crank up for the next heat.

Sponsors

USRA SERIES

APC Props (Series sponsor for props for T-6, F-1GT and Dominator)
Horizon Hobby
JR
Zenoah

BLUE WATER RIVER RUN EVENT

Aerosport
Antelope Valley Ford
Blue Water Resort and Casino
CRT
Eagle Tree Systems
Jack Thomas

Diego Lopez' Extra/Kelly F-1D won the Gold Trophy race in the F-1 GT class.

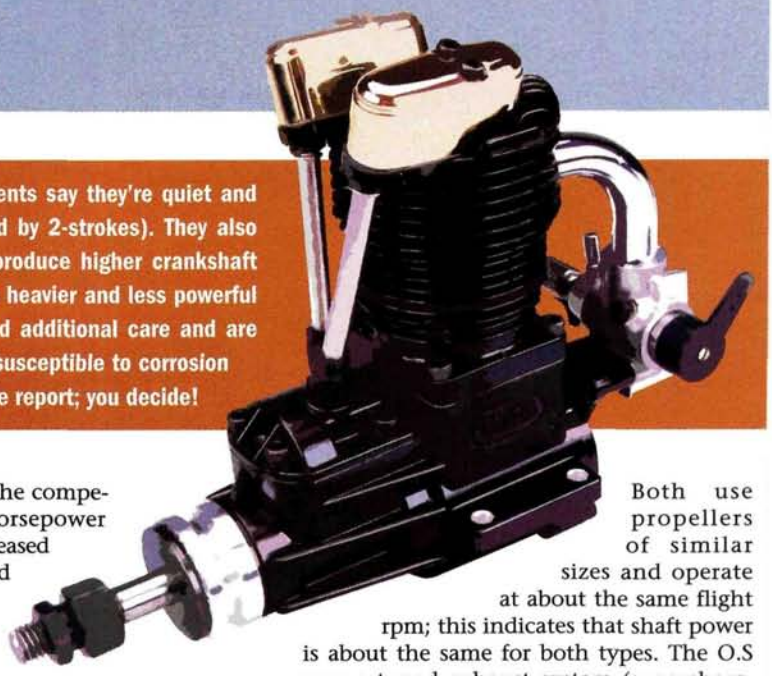
The Unlimited Scale Racing Association (USRA) organization promotes giant-scale racing; the Formula One GT and Dominator classes exemplify the forward thinking that helps bring newcomers into this fine sport. For more information on how you can compete in this adrenaline-pumping hobby, contact the USRA at P.O. Box 396, Mentor, OH 44060, or check out its cool website at usrainfo.org.

4-STROKE POWER

WHAT'S THE ADVANTAGE?

by Dave Gierke • illustrations by Paul Perreault

Four-stroke engines: some love them, some hate them. Proponents say they're quiet and sound scale (unlike the aggravating, high-rpm whine produced by 2-strokes). They also claim that 4-strokes are more fuel-efficient, run cooler and produce higher crankshaft torque to turn large propellers. Detractors contend that 4-strokes are heavier and less powerful than 2-strokes and that because they have more parts, they demand additional care and are proportionally more expensive. Four-strokes are also said to be more susceptible to corrosion than 2-strokes. Which of these claims and counter-claims are true? We report; you decide!



POWER

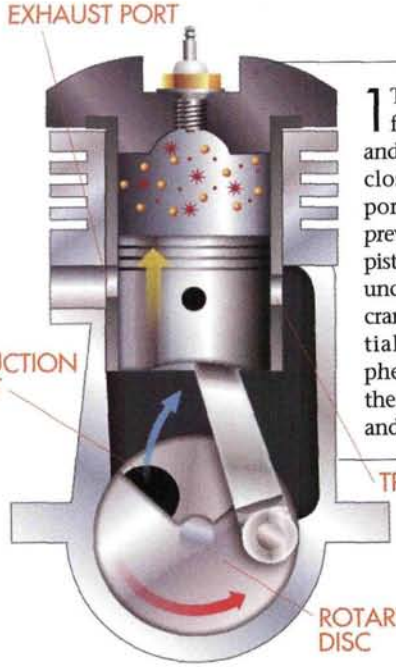
It has been said that 4-strokes offer high-torque output. This is based on superior cylinder filling during the intake operation and the resulting higher cylinder pressures during the power event. Although this is true, there is only one power stroke for every two revolutions of the crankshaft, and this reduces the engine's mean torque figures by half. A comparison of the torque produced by representative examples of similar displacement 2- and 4-stroke engines shows this (see "2-Stroke vs. 4-Stroke Power Curves").

Production 4-strokes from the late '70s and early '80s were under-powered compared with 2-stroke engines of the same cylinder displacement. In almost three decades of technical progress, highly developed forms of the 4-stroke engine have at last caught up to the competition 2-stroke: horsepower numbers were increased during this period by improving the engine's volumetric efficiency (breathing), increasing the valve lift and duration, and enlarging the valves and ports. Tinkering with combustion-chamber shapes also improved power while it stifled combustion defects such as detonation. Continued 4-stroke development focuses on supercharging and oxygen-bearing fuel components such as nitromethane.

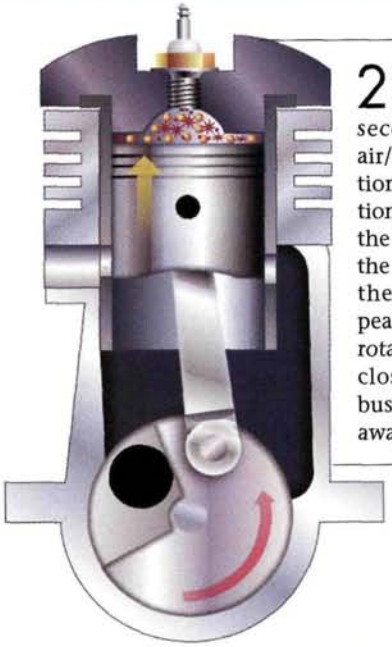
At the 2003 AMA Nationals, participants in several classes of RC aerobatics predominantly used the O.S. 1.40 (RX or EFI) 2-stroke engine or the YS 140 (L or DZ) 4-stroke. Both use propellers of similar sizes and operate at about the same flight rpm; this indicates that shaft power is about the same for both types. The O.S uses a tuned exhaust system (supercharging from the exhaust side) while the YS uses crankcase-pumped supercharging with 30-percent-nitromethane fuel. The noise levels of the most advanced 4-stroke designs are on a par with similarly developed 2-strokes, although proponents of the 4-stroke engine claim that the low-pitch exhaust damps the high-decibel effect on the human ear. The Academy of Model Aeronautics disagrees; noise attenuation must be applied equally for all internal-combustion engine types.

2-STROKE OPERATION

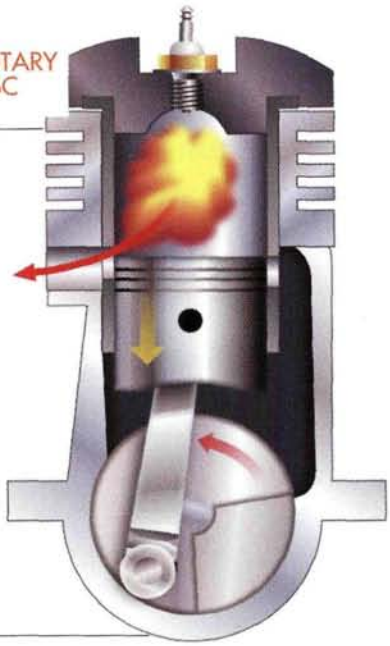
To understand how a 4-stroke engine operates, it helps to know how its glow-ignition 2-stroke counterpart works.



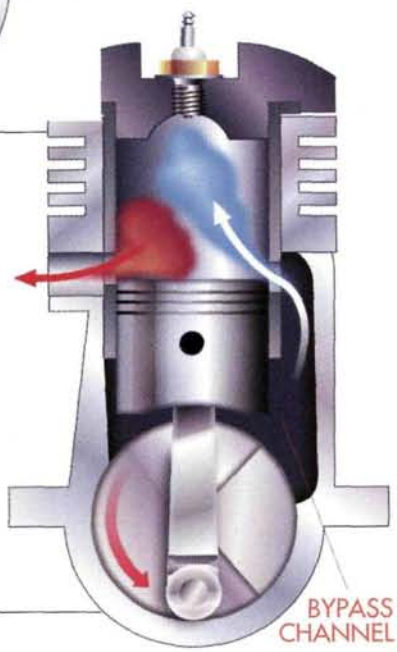
1 The crankshaft has rotated away from BDC (bottom dead center) and has moved the piston up and closed the transfer and exhaust ports. The air/fuel mix from the previous cycle is trapped above the piston. The induction disc starts to uncover the induction port. As the crankcase volume increases, a partial vacuum forms and atmospheric pressure pushes air through the carb, where it's mixed with fuel and enters the crankcase.



2 As the piston nears TDC (top dead center) on the secondary compression, the air/fuel mix reaches auto-ignition temperature and combustion occurs. The momentum of the rotating components carries the piston beyond TDC, where the expanding gases provide peak pressure. Meanwhile, the rotary induction valve is almost closed as high-pressure combustion gases push the piston away from the cylinder head.

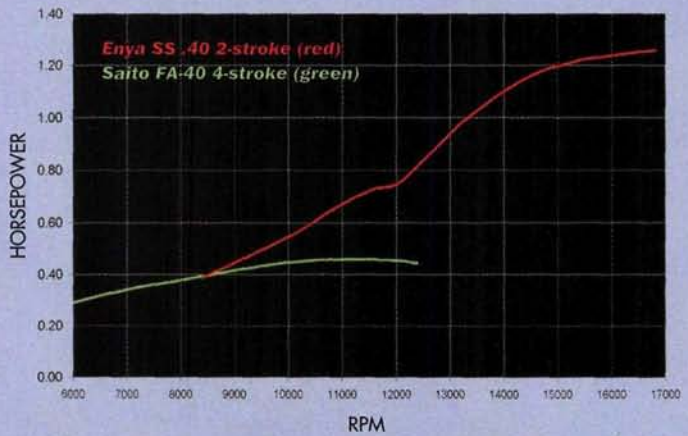


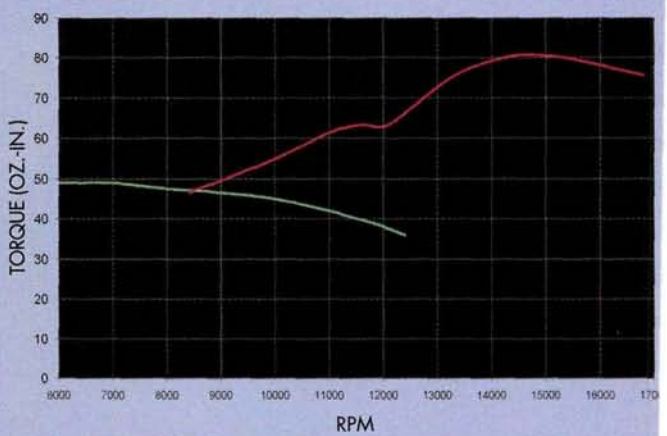
3 The piston moves to a point at which the power event ends and the exhaust port opens. The time between exhaust-port opening and transfer-port opening is called "exhaust lead." It provides time for the high-pressure exhaust gases to begin exiting the exhaust port. The induction valve is still closed; this allows the piston to compress the fresh air/fuel mix in the crankcase until the transfer port opens. The mixture then flows from the crankcase to the cylinder above the piston.



4 The exhaust and transfer ports are both open, and the previously compressed air/fuel mix flows through the bypass channel and transfer port and chases the tail-end gases out through the exhaust port. The 2-stroke may be simple in terms of its mechanical components, but the flow of energy through its systems is very complicated.

2-STROKE VS. 4-STROKE POWER CURVES





Two-stroke engines ultimately produce more horsepower than 4-strokes of equal displacement, as illustrated by the power and torque curves of the Enya SS .40 2-stroke (red) and Saito FA-40 4-stroke (green). But peak power isn't everything; with a .40-size airplane, the 2-stroke produces more horsepower at the extreme high end of the rev range, but that power is generated above the usable rpm for most flyers. At anything below about 9,000rpm, the 4-stroke is actually stronger.

4-STROKE OPERATION

While the 2-stroke engine has a power event for each revolution of the crankshaft, the 4-stroke requires two crankshaft revolutions to create a power event. Stated another way: at a given rpm, the 4-stroke produces half as many power events as the 2-stroke. The other primary difference between the two types involves the way gases are moved into and out of the mechanism: the 2-stroke uses piston-controlled ports; the 4-stroke uses cam-actuated poppet valves.

1 The piston moves away from the cylinder head (known as the "intake stroke") because of the momentum of the engine's rotary components. The exhaust valve is closed and the intake valve is opened to allow air/fuel mixture to be pushed into the partial vacuum of the expanding chamber by atmospheric pressure.

2 The second stroke is when the piston moves away from BDC toward the cylinder head. During this "compression event," the piston's motion is again extracted from the momentum of the engine's rotary components. Both the intake and exhaust valves are closed as the trapped air/fuel mixture is squeezed into the relatively small combustion chamber prior to ignition. The ignition of the mixture occurs somewhat before TDC, as it does with the 2-stroke engine.

3 The expanding high-pressure combustion gases push the piston away from the cylinder head toward BDC. Known as the "power, or expansion, operation," it represents the only stroke in the cycle that produces (rather than consumes) power. The intake and exhaust valves are closed.

4 During the fourth stroke, the piston moves from BDC toward the cylinder head—also driven by the engine's momentum. This is known as the "exhaust operation," and the exhaust valve remains open throughout the stroke. The intake valve is closed.

4-STROKE RECOMMENDATIONS

If you own or plan to buy a 4-stroke, read the directions supplied by its manufacturer. The additional information presented here is provided to help you avoid potential problems and enjoy running your engine.

• **Fuel.** Most modern 4-strokes operate on methanol-based (alcohol) fuel. Why? Primarily because of cost. The simple glow-plug ignition system works well with methanol (catalytic action) but not with gasoline, which needs an expensive spark-ignition system. In fairness, gas and spark proponents argue that over the long run, it's cheaper to buy the ignition system and run relatively inexpensive, fuel-efficient gasoline; glow fuel doesn't provide good mileage and it isn't cheap. From a safety perspective, gasoline is more dangerous than alcohol fuel owing to its volatility; having a fire extinguisher nearby is a must.

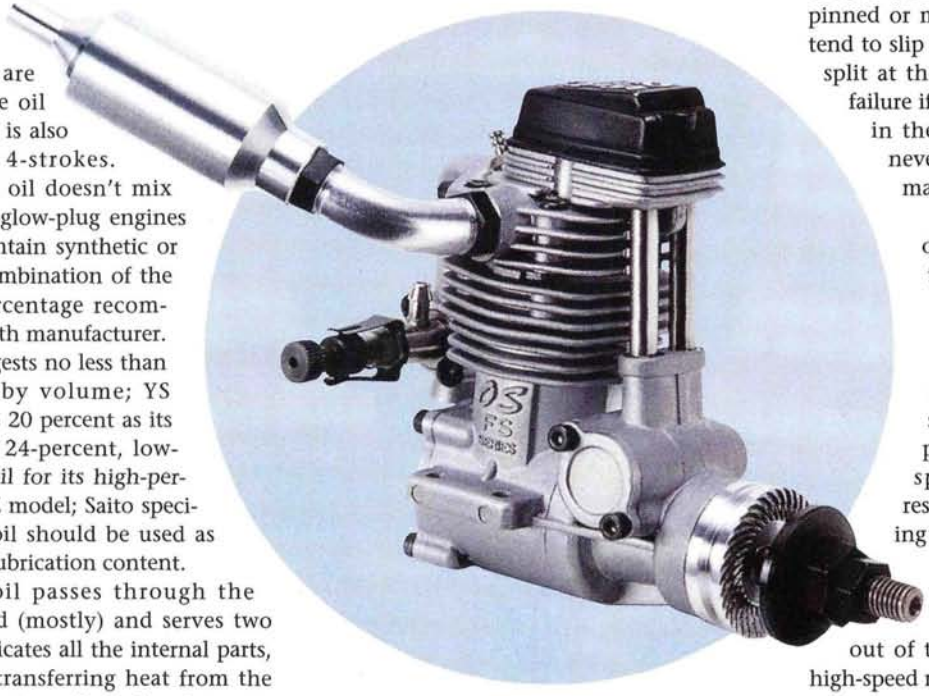
• **Lubrication.** Crankcase-scavenged 2-strokes are lubricated by the oil in their fuel; this is also true of most 4-strokes. Petroleum-based oil doesn't mix with alcohol, so glow-plug engines use fuels that contain synthetic or castor oil or a combination of the two. The oil percentage recommended varies with manufacturer. O.S. Engines suggests no less than 16 percent oil by volume; YS Engines points to 20 percent as its standard and to 24-percent, low-viscosity (thin) oil for its high-performance 140 DZ model; Saito specifies that castor oil should be used as part of the total lubrication content.

Two-stroke oil passes through the engine unburned (mostly) and serves two functions: it lubricates all the internal parts, and it cools by transferring heat from the hottest components, such as the piston, to the lubricant that passes out of the engine during the exhaust operation. Lubrication does the same for the 4-stroke, but with one difference: since the 4-stroke produces only one power stroke for every four strokes of the piston, in all but the most powerful designs, it naturally runs cooler. This has prompted many to think that a 4-stroke requires less lubricating oil. Cylinder pressures are, however, very high during the power operation; adequate lubrication is critical to the wristpin, crank pin and connecting-rod bushings. Higher oil percentages also offer a degree of safety with a lean needle-valve setting.

• **Nitromethane.** Adding nitro to methanol-based fuels increases power, improves idle and produces a better transition from idle to wide-open throttle for most engines, including 4-strokes. The percentage of nitro recommended varies with manufacturer/distributor. Bill Baxter of Hobbico suggests the use of 10- to 15-percent nitro across the board for all O.S. 4-strokes. YS recommends 20 percent for its 4-strokes. Again, check your engine's instructions.

Most commercial fuel blenders offer both the lubrication and the nitro content suggested by the engine manufacturer.

• **Glow plug.** In the beginning of the modern 4-stroke era, no one thought that the glow plug would work. With three non-firing strokes, how could the platinum-alloy wire element in the plug be expected to maintain its temperature? The original O.S. FS-60 was fitted with a special "hot" plug designated the "F," and it's still produced and used in all O.S. 4-strokes. The F plug is different from other 2-stroke "hot" plugs because its long snout extends into the combustion chamber. Within the snout, the wire element is directly subjected to elevated temperatures during combustion, exhaust and compression, and that helps it to maintain ignition temperature from cycle to cycle. There are several versions of the original F plug on the world market, but your choice of glow plugs should be dictated by your engine manufacturer's recommendations.



• **Propeller slippage.** Because 4-strokes are prone to detonation (a damaging, high-pressure spike in the combustion chamber) and considerable variations in torque delivery throughout the operating cycle (especially in single-cylinder engines), propeller hubs tend to slip against the serrated face of the engine's prop driver. This can loosen the prop nut and result in a "thrown" prop. A number of solutions have been incorporated to prevent this. Pinning the prop driver to the rear face of the prop hub was an early solution. Another method involved the use of full-length machine screws that extended through the prop washer and prop hub and into the drilled and tapped prop driver behind it. Four or six equally spaced screws are used with the prop nut at the front of the crankshaft.

Keeping the prop nut tight is another problem. O.S. and others use a second self-locking prop nut (jam nut) to minimize the chance of a propeller's being thrown. Check prop tightness after every flight. Because of torque and detonation, the prop—even a pinned or machine-screwed prop—will still tend to slip slightly. Wooden props can also split at the hub and cause a catastrophic failure if attention isn't paid to the grain in the hub area; wood grain should never be parallel to the pins or the machine screws.

During wide-open engine operation, a prop might be thrown because detonation, (identified by its "pinging" combustion noise) reverses the piston's direction before it reaches TDC. In 4-strokes, severe detonation causes the prop shaft to immediately stop spinning—with predictable results. Even the best prop-restraining systems are sorely tested by the relentless force of inertia.

To prevent detonation:

• don't squeeze the last rpm out of the engine by over-leaning the high-speed needle valve;

• run a couple of hundred rpm on the rich side of peak. If you hear pinging during needle-valve adjustment, immediately back it off rich.

When you run any engine—especially a 4-stroke—the only safe position is behind the beast; be sure to also direct helpers and spectators accordingly. Using a fuel with a lower nitro percentage will help to minimize detonation. Reducing the propeller load by using a prop with a smaller diameter and/or pitch will also help.

Since detonation rarely occurs at partial throttle, you may avoid throwing a prop by snapping the throttle closed at the first indication of pinging. Atmospheric conditions also play a role with detonation: hot dry air promotes it, and cool, humid conditions discourage it.

DEVELOPMENT OF THE 4-STROKE

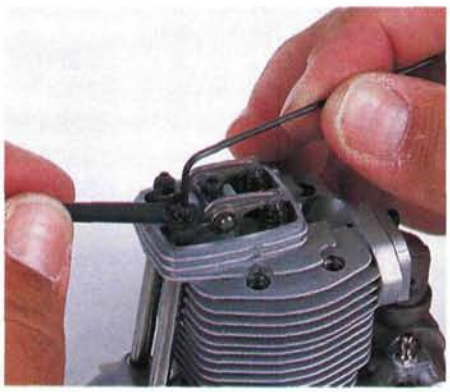
The first mass-produced, commercially available, miniature 4-stroke engines available in the U.S. were manufactured by the Feeney Engine Co. of Chicago. Announced in a full-page ad in the April 1940 edition of *Model Airplane News*, the engine was available in three cylinder displacements: 0.604, 0.914 and 1.18ci. Like most modern 4-strokes, these spark-ignition, single-cylinder designs used pushrod-actuated overhead valves. Feeneys were crudely constructed, and wary modelers soon rejected them as gimmicky, overpriced, overweight, poor performers. The company was forced to cease manufacturing because it had wartime government contracts and faced shortages of crucial materials.

Although the 4-stroke has a long history after the Feeney, the most significant event was the release of the O.S. FS-60 in 1976. This was the first 4-stroke to achieve widespread acceptance. It used a glow plug and ran on ordinary 2-stroke fuel, so the transition from 2- to 4-stroke was easy: no spark ignition, no gasoline and oil—no hassle! The FS-60 developed less than half as much power as its highly refined, 2-stroke counterparts of similar displacement, and it was promptly dismissed as inferior by competition fliers. Sport fliers, however, were quick to recognize the FS-60's attributes: quiet, relaxed flying for slower models and great fuel economy. The FS-60 looked like a 2-stroke except for its rear housing, which contained the camshaft, two exposed rocker arms and two thin pushrods behind the cylinder. A well-built engine, the FS-60 remained in production for seven years. After seeing modelers' enthusiastic responses, other manufacturers jumped on the bandwagon, and Kalt, DAMO, Shillings, Saito, Enya and Webra soon followed with their versions of the single-cylinder 4-stroke.

Used for sport planes, scale models and aerobats, 4-strokes were soon popular with model-aviation enthusiasts around the world, but with a 10cc (0.61ci) cylinder-displacement limit, they were not competitive against the high-horsepower 2-strokes used in Fédération Aeronautique Internationale (FAI) competition. In 1981, the rules were changed, and that leveled the playing field. While the 10cc limit remained in force for 2-stroke engines, scale RC models could now use up to a 15cc (0.915ci) 4-stroke, and RC aerobats could use up to a 20cc (1.22ci) 4-stroke. This was great news for manufacturers of 4-strokes, and they plunged into design and development.

For FAI and national competition, 2-stroke engines are now allowed the same displacement limit as 4-stroke engines. A steady improvement in design, manufacture and operation of the most advanced 4-strokes is responsible for this change.

MAINTENANCE



The number-one maintenance problem associated with all model internal-combustion engines is corrosion: the rusting of the internal parts. With 4-strokes, this is especially difficult to control because the crankcase, which houses the ball bearings, crankshaft, camshaft, camshaft surfaces and timing gears, is partly sealed.

There's a controversy about why these components rust. Is it the result of the corrosive gases generated during the combustion process? Could it be promoted by the hygroscopic (water-attracting) action of the methanol in the fuel? Is there a problem with the modern synthetic lubricants in the fuel? Does brass (the tube and "clunk" in the tank) react with fuel components to produce an acid that encourages rust? Maybe it's a combination of these or something not yet considered. One thing is certain: to control rust, before you put your engine away, you must purge the crankcase of residual fluid and replace it with after-run oil. Over the past quarter century, a consensus has gradually evolved.

At the end of every flying session, run the engine at a peaked wide-open throttle for about 20 seconds, and then pull the fuel line off the carburetor (if you can). Using a syringe, inject rust-inhibiting oil through the crankcase breather fitting and rotate the propeller. Tip the engine in various directions to ensure complete component coverage.

Eight to 10 drops of oil dripped into the glow-plug hole while you turn the engine over will lubricate the valve components and ensure that the meehanite (iron) compression ring on the piston is taken care of.

click trip MODELAIRPLANENEWS.COM FOR IN-DEPTH INFO ON VALVE TIMING

The amount and type of oil you use in the crankcase will depend on the engine's displacement and the recommendations of its manufacturer. Example: for a 10cc (0.61ci) engine, I would use about two tablespoons of Marvel Mystery Oil. Bill Baxter of Hobbico's engine-repair department also recommends Marvel Mystery Oil, Marvel Mystery Air Tool Oil, automatic transmission fluid and a non-graphite gun oil. He says that if the engine is new, WD-40 is an excellent choice. Clarence Lee points out that WD-40 isn't recommended for engines that have already rusted because it breaks rust free of the parts and allows this abrasive iron oxide to wreak havoc on components.

FINAL THOUGHTS

Although the 4-stroke engine isn't the newest prime mover on the block, it offers a bright future for modelers in terms of performance, noise abatement, realism and product longevity.

by Scott Hampton

THE WORLD MODELS

Zero G.S.

Fearsome WW II fighter in giant scale

The Japanese Zero is arguably one of the most recognizable planes in aviation history. Infamous for the strategic role played in the attack on Pearl Harbor, the Zero—with the unmistakable sun emblazoned on its wing—had the power t strike fear in the hearts of enemy pilots worldwide. Today, the Zero remains just as notable, but now, as one of the mos often-replicated planes in the modeling industry. The new 1.60-size Zero from The World Models is a well-built, high-quality tril ute to an aviation icon; it's sure to grab just as much attention as its full-size counterpart.

PHOTOS BY JOHN REID

Models don't come much nicer than this! This is exactly what you'll find when you open the box.

SPECIFICATIONS

MODEL: Zero G.S.

MANUFACTURER: The World Models Mfg. Ltd.

DISTRIBUTOR: Airborne Models

TYPE: giant-scale WW II fighter ARF

WINGSPAN: 80 in.

WING AREA: 1,085 sq. in.

LENGTH: 67.7 in.

WEIGHT: 15.5 lb.

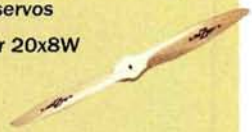
WING LOADING: 33 oz./sq. ft.

ENGINE REQ'D: 1.60 2-stroke glow

ENGINE USED: Moki 2.10 2-stroke glow

RADIO REQ'D: 6-channel w/9 servos (elevator, rudder, throttle, retracts [2], ailerons [2] and flaps [2])

RADIO USED: Airtronics RD 6000 w/2 Hitec HS-75BB retract servos and 7 Airtronics 94102 servos



PROP USED: Zinger 20x8W

FUEL USED: PowerMaster 5%

PRICE: $549.99

FEATURES: fiberglass fuselage; built-up balsa wing; comes with a fiberglass cowl and air scoop; retracts already installed; complete hardware package that includes fuel tank, wheels, engine mount, control horns, all the pull-pull equipment and a spinner.

COMMENTS: the Zero G.S. features beautiful lines, and the paint scheme really is something to be seen in the air. The Zero is very easy to build and performs beautifully.

HITS

- High-quality hardware included.
- Fast, easy assembly.
- Hand-painted fiberglass fuselage.

MISSES

- None.

IN THE BOX

This giant beauty comes in one of the most complete packages that I've ever seen. In addition to a fiberglass fuselage, the Zero features nicely covered, built-up balsa wings and tailpieces. The two-piece wing is detachable, as is the stabilizer. Additional features include hinged flaps, an elevator bellcrank, an anti-vibration engine mount and installed, spring-loaded, retractable landing gear. A scale plastic spinner, a painted fiberglass cowl, canopy and pilot and a complete set of hardware round out this all-around excellent package. An optional drop tank is also available; of course, I chose to include it on my model.

The Zero requires a 1.60 2-stroke engine, a 6-channel radio and nine servos. I decided to power mine with a Moki 2.10 2-stroke, and I used a combination of Hitec and Airtronics radio equipment for control.

ASSEMBLY

Wing. Most of the work on the wing is already done! I first made sure that all of the hinges were securely glued into place and moved freely, and then I began the assembly process with the installation of the flap and aileron servos.

The aileron servo panels come already drilled, so I began by gluing the mounting blocks into place with 30-minute epoxy. When the epoxy dries, mount the servos to the blocks, and run the servo wires through the wing. Connecting the aileron servos requires the use of a 24-inch Y-harness; two 12-inch Y-harnesses are required for the flaps and retracts. I used standard Airtronics 94102 servos for the flaps and ailerons and Hitec metal-geared HS-75BB servos for the retracts. I secured the aileron servo trays to both sides of the wing using the provided screws.

Next, I installed the flap servos following the same procedure as I used for the aileron servos. Everything fit beautifully in the wing. I then installed the control horns for the flaps and ailerons; the kit provides a very nice set of control horns—perfect for a plane of this size. After I installed the pushrods, I turned on the radio and checked for smooth movement.

The Zero even comes with a painted pilot figure and canopy—now that's a complete package.

When I was satisfied with the operation of the control surfaces, it was time to connect the retractable landing gear. The landing gear and pushrods come installed in the wings; you simply have to mount the retract servos in the wing and connect them to the servo arms. Because the retract servos are on top of the wings, two pieces of MonoKote are provided to cover the holes.

With the retracts completed, it was time to join the wing halves. The provided joiner tubes fit perfectly in both halves. A nice set of L-brackets is provided to secure the halves together. Installing the L-brackets was a bit time-consuming; drilling the necessary holes

Mitsubishi Zero: terror of the Pacific

Zero! Although usually a number signifying nothing, to those who know history, it indicates an able foe; a dainty but lethal dancer that cut a swath so bloody across the Pacific that for the first six months of WW II, it appeared as if nothing could stop it.

The stories that filtered back from the South Pacific initially painted a bleak picture: the Japanese had a secret weapon that could turn so sharply and hit so hard that our Wildcats and P-40s were helpless against it.

The stories were so pervasive—and the victories so lopsided—that the Japanese began to believe that their airplane was invincible. But they were wrong. Our pilots quickly learned how to fight the little devil (never turn with it; use slash-and-dash techniques). More important, the Zero was so successful that Japanese High Command saw no reason to plan for a follow-on design—a fateful decision. Allied technology moved ever forward, eventually fielding designs that would rewrite the War's outcome.

The secret of Mitsubishi's Reisen Type Zero A6M (code name "Zeke") series of airplanes was a low power-to-weight ratio. When the design specifications were laid down in the late '30s, there were few engines in Japan that put out much more than 1,000hp, so Mitsubishi designer Jiro Horikoshi had to meet the government's goals with modest power. To get the speed and range demanded by the specifications required the Zero's builders to construct an airframe that weighed 4,300 pounds empty—about the same weight as an AT-6 Texan. A Hellcat weighed more than twice that.

The Japanese High Command was also mired in the belief that aerial combat always came down to the turning dogfight typical of WW I, in which a light wing loading was necessary to pull a tight circle. However, the very key to its success—its light weight—was also one of the keys to its undoing.

To build the airplane that light, Horikoshi had to eliminate as much metal as he possibly could. Toward that end, he made the fuselage formers an integral part of the wing spar and eliminated the center section. The one-piece wing made it impossible to produce sub-components in widely scattered, easily protected cottage-industry workshops.

The Zero was wildly labor-intensive, and that is why barely 10,000 of them were built during its seven-year lifespan. Nearly every American fighter topped the 10,000 mark in only half that time.

The super-light structure also meant that the six .50-caliber machine guns on an American fighter could literally chew it to pieces. As the Zero had been designed strictly as an offensive machine, Japanese Command saw no reason to mount self-sealing gas tanks or pilot armor. They couldn't envision anyone getting in position to shoot at it, so why protect the pilot? Enemy arrogance may well have been the single largest contributing factor to Allied victory.

By the end of the first year of the War, we knew how to fight the Zero. By the second year, the rugged and tight-turning Grumman F6F Hellcat and tank-like Corsair were able to take the fight to the enemy and whip them on their own playing field.

The Japanese eventually did put some competitive fighters into the fray, but they were too little, too late. In the end, the Zero and its peer group were overpowered by sheer numbers and advancing technology, and—once the scourge of the skies—the Zero was reduced to a scrappy little foe just trying to survive.

—Budd Davisson

requires a steady hand. Once you've bolted the halves together, the wing is complete; it takes only a couple of hours.

Engine installation. The holes in the firewall are already drilled out, so I test-fit the Moki 2.10 to the fuselage, and I found that it fit just fine. The engine mount is a neat, vibration-free system. You can mount the engine upright or sideways simply by rotating the engine mount; thrust angles will not be affected. I installed the blind nuts in the back of the firewall and tacked them down with some CA. I then marked and drilled out the holes on the engine mount and mounted the Moki on the firewall. Using a Pitts-style muffler, everything fit perfectly; even the throttle pushrod hole matched up.

I installed the throttle servo and the fuel tank next. I assembled the fuel tank and slid it into place. I packed foam around it and secured it with a balsa brace that I glued into place just behind the tank. For this plane, I decided to use three lines in the fuel tank:

> The best thing about this plane is its performance in the air.

feed, fill/drain and vent. I hooked up the feed line to the carburetor, and after installing the cowl, I connected the vent and fill/drain lines.

I used an Airtronics 94102 standard servo for the throttle. I glued the servo tray into place with 5-minute epoxy then mounted the servo to the tray. There is plenty of room inside the fuselage to do all the work you need. I ran the control rod through the firewall, attached it to the throttle arm on the carburetor and then connected it to the servo arm. All of the pushrod material is provided for this step.

With the engine installation complete, it was time to install the cowl. This is the neatest part of this ARF. The Zero comes with a clear, 3D cowl to serve as a template; make all of the necessary cuts in the 3D cowl, then simply transfer them to the main cowl. I first attached the aluminum plates to the cowl and then marked all of the locations where I would make cuts. When I was happy with the fit of the template, I transferred it to the main cowl. I then cut out all of the holes on the main cowl and transferred the aluminum plates. With the cowl installed, I mounted the prop and spinner.

Tailpieces. The tail surfaces were very easy and quick to install. I first measured out 172mm across one half of the elevator and

FLIGHT PERFORMANCE

TAKEOFF AND LANDING

The Zero tracks very well on the ground; with the engine set just above idle, I taxied onto the runway. I turned the plane around for the initial takeoff and added power. With the Moki 2.10 swinging a 20x8 prop, the tail came off the ground in about 10 feet. I was ready to input right rudder, but to my surprise, the plane tracked straight and true, and the plane's climb-out is nice and gentle.

The Zero lands like a low-wing trainer. Thanks to its large wing area and with its flaps down, it seems to take forever to get the wheels on the ground. With the throttle set slightly above idle, I made one flyby to see what the plane would do. I then came around for the final approach. With the throttle still set at a little above idle, I just let the plane slow down, touch the ground and then roll out.

LOW-SPEED FLIGHT

At about ¼ throttle, there is absolutely no roll-out when I pull up on the stick; the plane simply fell nose-down. At low speeds, the plane just lumbers along and flies straight and true.

HIGH-SPEED PERFORMANCE

You will be amazed by how well the Zero flies at full throttle. With full power, the Zero flies as though on rails. With the Moki 2.10, this plane is a rocket; the speed is very close to scale.

As it comes out of the box, the Zero has a gray bottom, but I wanted my model to really stand out. I painted the bottom orange to replicate the Zeros that served as transitional trainers.

AEROBATICS

The Zero is capable of the basic warbird maneuvers—loops, rolls, split-S's, etc. The Moki 2.10 provides more than enough power to accomplish these with ease. With the transmitter set to full rates, I was able to do the same maneuvers but with more authority.

drilled a 2mm hole 48mm from the trailing edge for the mounting screw. I then repeated this step on the other half and installed the control horns; these are also included in the kit. The next step was to slide the supplied aluminum tube through the fuselage to join the stabilizer halves. I then screwed the halves onto the spar and checked the distance from the nose to the tail to ensure that they were straight.

The next step was to install the vertical fin. This was also very simple, but I first had to install the tailwheel. With a little coaxing, I finally got the wire through the top and bottom of the fuselage. I then test-fit the fin into the slot and landing gear. After a little sanding, I was ready to install the rudder. Using 30-minute epoxy, I glued the fin into place. While the epoxy dried, I checked to see whether it was straight and true. When everything was dry, I attached the control horns to the rudder.

The pull-pull controls for the rudder and elevator are among the easiest that I have ever worked with. The Zero comes with a very neat elevator linkage, but the pieces are small, so be careful. After installing the linkage, I ran the wires back to the elevator servo (Airtronics 94102 standard servo). I then attached the adjustable ends of the wire to the servo arm, clamped everything together and plugged it into the receiver. The end result is a very smooth and responsive elevator.

The rudder also uses a pull-pull system. This step is very fast and easy. Simply run the cable through the tail of the fuselage and connect the wire to the control horns on both sides. I connected the adjustable ends of the wires to the servo arm and hooked the servo up to the receiver. After I had adjusted the wires slightly to make them equal lengths, the rudder was complete.

Final details. At this point, only the receiver, battery, decals and cockpit were left to finish. I started by plugging everything into the receiver and then securing it to the fuselage. I positioned the receiver on the back end of the mounting tray; this allowed me plenty of room to plug in the wing servos. Because I knew the model would be slightly tail-heavy, I decided to place the battery up front, behind the firewall. I wrapped the battery in foam and slid it right beside the fuel tank, opposite the throttle pushrod, and connected it to the switch.

The included painted fiberglass cowl really contributes to the Zero's authenticity. Check out those scale details!

The Zero comes with three sheets of high-quality decals. I cut out all of the decals that I wanted to use and applied them to the various spots on the plane, using a rag to press them into place and prevent any bubbles.

The pilot figure comes painted and ready to go; I simply had to apply some double-sided tape and mount it in the cockpit. The canopy comes already drilled out and painted as well. I marked the locations on the fuselage for the matching holes, drilled them out using a 2mm drill bit and attached the canopy with the supplied screws.

Last, I decided to give my Zero a unique touch. Because I wanted it to really stand out, I painted the bottom of my model orange. This was the color scheme used on Zeros that served as transitional trainers.

CONCLUSION

The 1.60-size Zero from The World Models is one of the easiest models I've ever built. I was able to complete the entire project in just 10 to 12 hours—quite an amazing build time for a plane of this size! But the best thing about this plane is its performance in the air. Its beautiful lines and striking scale appearance are truly a sight to see streaking across the sky! ✈

Airtronics (714) 978-1895; airtronics.net.
Hitec RCD Inc. (858) 748-6948; hitecrcd.com.
Moki Engines; distributed by Horizon Hobby Inc. (800) 338-4639; horizonhobby.com.
PowerMaster Hobby Products Inc; (512) 285-9595; powermasterfuels.com.
The World Models Mfg. Co. Ltd.; distributed in the USA by AirBorne Models (925) 371-0922; theworldmodels.com; airborne-models.com.
Zinger; distributed by J&Z Products (310) 539-2313; zingerpropeller.com.


TOPMODEL CZ

NORTHEAST SAILPLANE PRODUCTS

Rebelove

by Craig Trachten

Heart-stopping 3D sensation

Traditionally, I have started model reviews such as this by relating some obscure fact about the full-size aircraft or making a cute play on words using the name of the model—but this one threw me! Manufactured by Topmodel CZ in the Czech Republic and distributed by Northeast Sailplane Products, the Rebelove is nothing if not unique. At first sight, I was convinced that the Rebelove had been genetically engineered. The manufacturer appeared to have started with a pattern-shaped body and then grown fun-fly wings and tail feathers on it, but somehow, this hybrid turned out to be one of the best flyers that I have ever owned.

I was impressed with the quality of the Rebelove from the moment I opened the box. All the parts of the main airframe come nicely built up and covered with Oracover.

SPECIFICATIONS

MODEL: Rebelove

MANUFACTURER: Topmodel CZ

DISTRIBUTOR: Northeast Sailplane Products

TYPE: 3D aerobat

WINGSPAN: 61.5 in.

WING AREA: 1,084 sq. in.

LENGTH: 64.5 in.

READY-TO-FLY WEIGHT: 7 lb.

WING LOADING: 14.89 oz./sq. ft.

ENGINE REQ'D: .60 to .90 2-stroke or .91 to 1.00 4-stroke

ENGINE USED: O.S. .91 pumped Surpass 4-stroke

PROP USED: Master Airscrew 12x6

RADIO REQ'D: 4-channel w/5 servos (elevator, rudder, throttle, ailerons [2])

RADIO USED: Futaba 9C w/2 FMA 500 (ailerons), 2 FMA 700 (elevator and rudder) and 1 FMA 300 (throttle) servos

FUEL USED: Wildcat 30% Helimax

PRICE: $329.95

FEATURES: expertly built and covered with Oracover; complete hardware package that includes a gelcoated fiberglass cowl and aluminum landing gear; kit also includes a transparent PVC canopy, detailed cockpit decals and aluminum wing joiners.

COMMENTS: I have never had an aircraft that was such a pleasure to build. Although the package lacked printed instructions, the construction photos were more than sufficient. The only thing that was more enjoyable than building the Rebelove was flying it. It can be as docile as the best low-wing trainer or as wild as your imagination.

HITS

- Complete hardware package.
- Nice fit and finish of all components.
- Excellent flight performance.

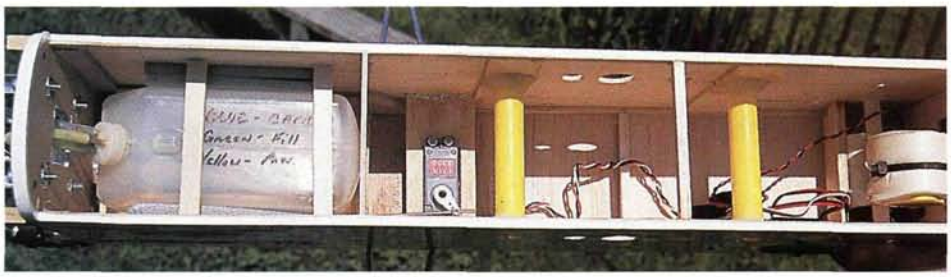
MISSES

- None.

KIT CONTENTS

When you open the box, you'll find the fuselage, wings and tailpieces built up and expertly covered with Oracover. In addition to pushrods and control horns, the complete hardware package includes aluminum landing gear and wing joiners. Among the more notable supplied accessories are a gelcoated, epoxy fiberglass cowl, a transparent PVC canopy and a complete set of decals, including several that depict cockpit details.

The Rebelove isn't intended for beginners; the package lacks written instructions, but the supplied booklet of construction drawings contains more than enough information for the more experienced builders/pilots for whom this model was designed. I, for one, was grateful not to have to dig through page after page of "glue part A to part B" to find the information that I needed.



The interior of the fuselage seems cavernous! Because the rudder and elevator servos are mounted on the tail, there's more than enough room in the radio box for just about any installation arrangement.

ASSEMBLY

Wing. The first step is to install the aileron servos. Cut out the covering over the servo bays and use an iron to secure the edges. The manual recommends that you epoxy the servo trays into the bays and then install the servos in them. Instead, I mounted the servos on the trays and then installed the trays in the wing. Doing so eliminated the guesswork and measuring normally involved in determining the proper height and angle of the servo placement.

Next, I epoxied the aileron hinges into place. For added peace of mind, I further secured the hinges with pins. I also installed Sullivan ¾-inch steel control horns in place of those supplied in the kit—again, for peace of mind. At this point, you should also attach the included hooks to each wing half. When used in conjunction with a hefty rubber band, these hooks will later secure the wings to the fuselage.

Engine. The Rebelove can be powered by a variety of engines, so you have a choice here. I decided to install an O.S. Surpass .91 pumped 4-stroke turning a Master Airscrew 14x6 prop; I used an O.S. aluminum mount. I couldn't have picked a better power combination for this aircraft. The power, weight and performance of the engine, prop and plane are a match made in flying heaven. Your engine can be mounted in any orientation you choose. I chose to mount mine inverted, as I try to do whenever possible; I find it easier to make cuts in the cowl. Inverted engines also allow a much cleaner appearance.

Tailpieces. Assembling the tailpieces is a fairly standard procedure. The process varies little from that used in most ARF assemblies, but drilling mounting holes for the split elevator's connecting wire does require some extra care. The holes must be parallel to each other and perpendicular to the surface to prevent any alignment problems after the horizontal stabilizer has been installed. Here, Hobbico's Quick Hand Drill gave me the control that I needed to complete this task quickly and accurately.

FLIGHT PERFORMANCE

On the first flight, the O.S. .91 fired right up, and I taxied around to get a feel for the aircraft. It handles so smoothly on the ground that, for a moment, I thought I was driving an RC car. If that was any indication of the Rebelove's flight capabilities, I knew I was in for quite a ride!

I set up the controls using the recommended throws and exponential. I set my low rates to the standard setup and used the 3D setup for my high rates.

TAKEOFF AND LANDING

I slowly added throttle as the aircraft headed straight down the runway; it quickly built up speed and started the climb-out by itself. Our field is somewhat on the short side, so I have to add a little up-elevator to get the Rebelove over the high grass at the end of it. Otherwise, the Rebelove would have taken off by itself. That I didn't have to make any trim adjustments is a testament to the quality of this kit. At altitude, this plane flies straight and level at ½ throttle. Add throttle, and it will gradually climb; reduce throttle, and it will gradually descend.

Landings are almost hands-off. I simply line up with the field and chop the throttle to an idle; the Rebelove flies in and touches down like a feather.

LOW-SPEED PERFORMANCE

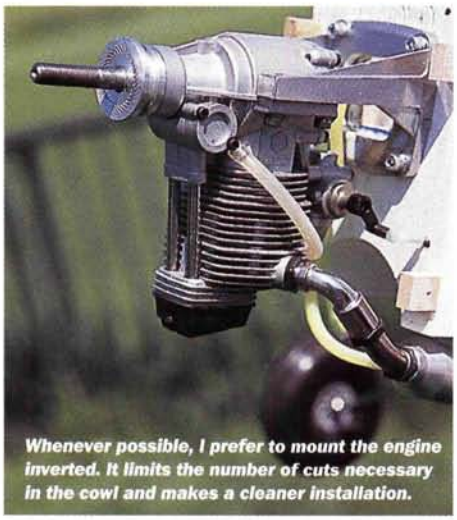
At slow speed and low rates, this aircraft makes a great low-wing trainer. It goes where you point it and shows absolutely no bad characteristics.

HIGH-SPEED PERFORMANCE

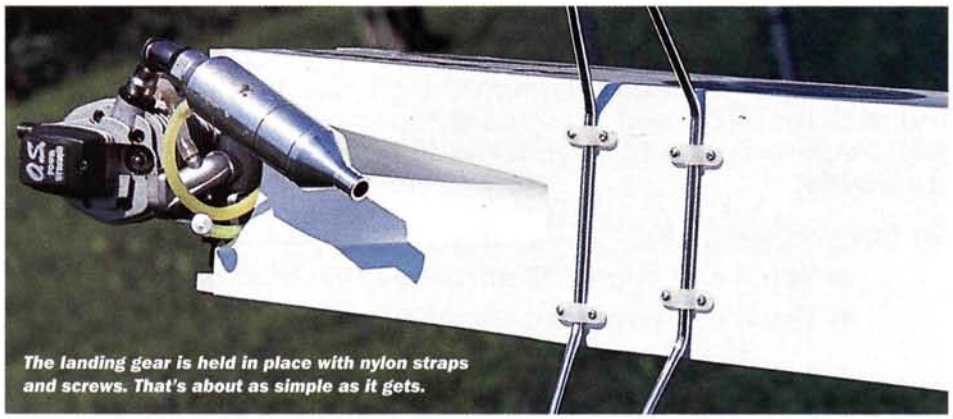
I don't recommend that you fly the Rebelove at high speeds. This is an aerobatic aircraft; it was not designed to break speed records. With that said, I did make one high-speed pass during which the tail feathers fluttered slightly. I later installed flying wires, and they seem to have solved the problem.

AEROBATICS

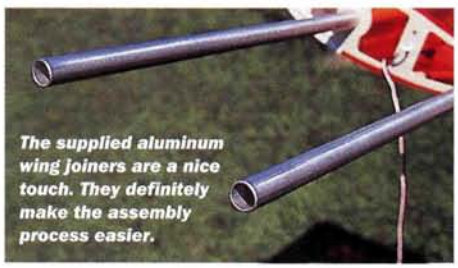
This is what the Rebelove was designed to do. It will perform whichever maneuvers you tell it to and make you look like a great pilot in the process. The Rebelove is the most stable, axial platform that I have ever flown. Need I say more?



Whenever possible, I prefer to mount the engine inverted. It limits the number of cuts necessary in the cowl and makes a cleaner installation.



The landing gear is held in place with nylon straps and screws. That's about as simple as it gets.



The supplied aluminum wing joiners are a nice touch. They definitely make the assembly process easier.

To complete the tail assembly, attach the horizontal stabilizer to the fuselage, followed by the tailwheel bracket. Last, attach the rudder.

Finishing up. The next step was to attach the turtle deck to the fuselage, and here, I deviated from the booklet slightly. The procedure outlined in the construction drawings involved more work than is really required. Want to save some time? First, epoxy the front dowels and rear tabs to the turtle deck as pictured in the booklet; then cut the mounting plate at the rear of the cabin to leave a small shelf. Place the turtle deck on the aircraft, and drill holes through the fuselage and mounting tabs on each side. Take the turtle deck off, and glue a piece of pushrod chase from tab to tab, covering both holes. I used the turtle deck mounting wire to align the tube over the holes. Using this method will save you some time and eliminate a great deal of frustration.

Next, cut out and glue the printed cockpit detail sheet; thinned white glue works well here. Trim and glue the canopy to the deck; to finish off the deck, I applied some trim tape.

The next step is to cut open the front of the cowl. A 3/8-inch sanding drum attached to my Dremel tool made short work of that task. Be sure to measure and trim the cowl to fit your engine. Because I mounted my engine inverted, and I hate having to reach underneath the model to remove the glow driver, I installed a Du-Bro remote glow driver. Last, mount the landing gear as pictured, check the CG and get ready for some high-flying action!

CONCLUSION

The Rebelove is an all-around winner. Rarely do I enjoy building and flying an aircraft as much as I did this one. Experienced pilots who want some serious 3D fun need look no further than the Rebelove.

Du-Bro Products *(800) 848-9411; dubro.com.*
Dremel Tool *(800) 437-3635; dremel.com.*
FMA Direct *(800) 343-2934; (301) 668-4280; fmadirect.com.*
Futaba; *distributed by Great Planes Model Distributors; futaba-rc.com.*
Great Planes Model Distributors *(217) 398-6300; (800) 682-8948; greatplanes.com.*
Hobbico; *distributed by Great Planes Model Distributors; hobbico.com.*
Master Airscrew; *distributed by Windsor Propeller Co. (916) 631-8385; masterairscrew.com.*
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Sullivan Products *(410) 732-3500; sullivanproducts.com.*
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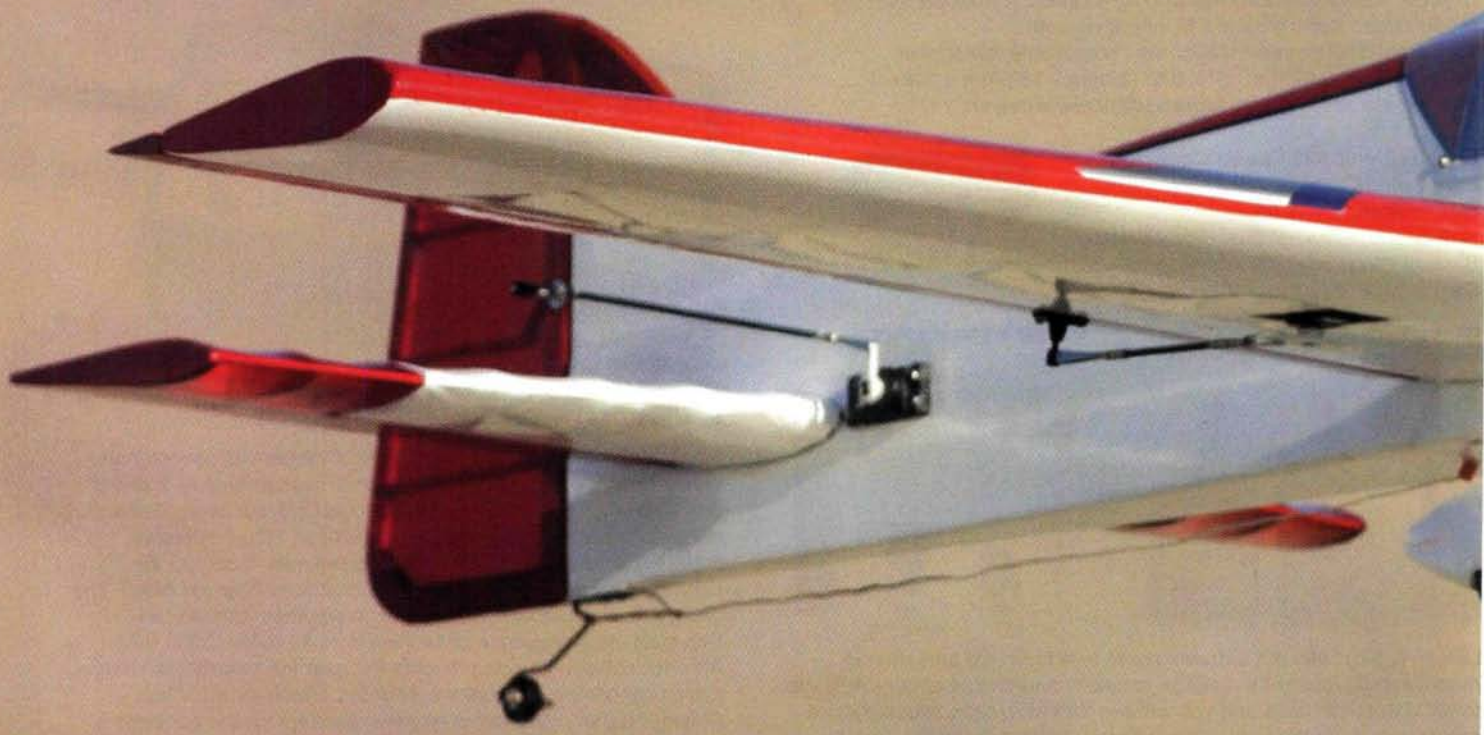
OK MODELS

Seduction Free Style

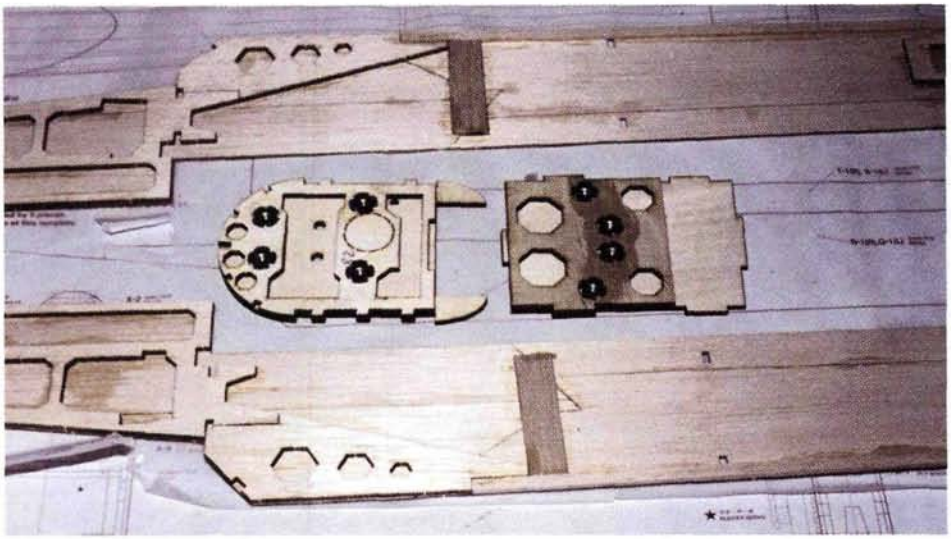
by Bobby Corbett



Action-packed 3D aerobat

For several decades, OK Models has been an established leader in the RC industry—well known for producing some of the highest-quality models on the market. Now MRC is introducing a whole new generation of budding pilots to OK's EZ line of high-quality ARFs and its Pilot series of precisely laser-cut kits. The Seduction Free Style, one of the newest additions to the Pilot series, is an adrenaline-pumping, 3D aerobat that remains faithful to the OK tradition of quality. It may take a little longer to get in the air than its ARF counterparts, but it's well worth every second!

PHOTOS BY BOBBY CORBETT & JOHN REID



The fuselage sides, the formers and the firewall are made by gluing several laser-cut pieces together. Note the position of the side doublers and the alignment tabs and slots that speed construction. Be sure to make a left and a right side.

SPECIFICATIONS

MODEL: Seduction Free Style

TYPE: freestyle 3D aerobat

MANUFACTURER: OK Models Co.

DISTRIBUTOR: MRC

WINGSPAN: 52.4 in.

LENGTH: 54.3 in.

WING AREA: 550 sq. in.

WEIGHT: 70 to 74 oz.

WING LOADING: 18.4 to 19.5 oz./sq. ft.

ENGINE REQ'D: .30 to .40 2-stroke or .40 to .60 4-stroke

ENGINE USED: Enya Super Sport .40bb Schnuerle

RADIO REQ'D: 4-channel w/5 servos (rudder, throttle, elevator and 2 ailerons)

RADIO USED: Airtronics Radiant 6-channel with a 92765 receiver and 5, 94102 heavy-duty servos

PROP USED: APC 10x7

FUEL USED: Wildcat 15%

PRICE: $160

FEATURES: laser-cut balsa and ply parts; one-piece clear plastic cowl and canopy, wingtips, wheel pants and an engine mount included.

COMMENTS: the Seduction Free Style is another great addition to the OK Models Pilot series of high-quality, built-up kits. All of the parts are precisely laser-cut, and highly detailed plans leave little room for error. When it's flight-ready, stand back and get ready for some heart-stopping, 3D action.

HITS

- High-quality, laser-cut parts.
- Lightweight construction.
- Choice of 3D or sport version.

MISSES

- Decals not supplied.
- Minimal instructions.

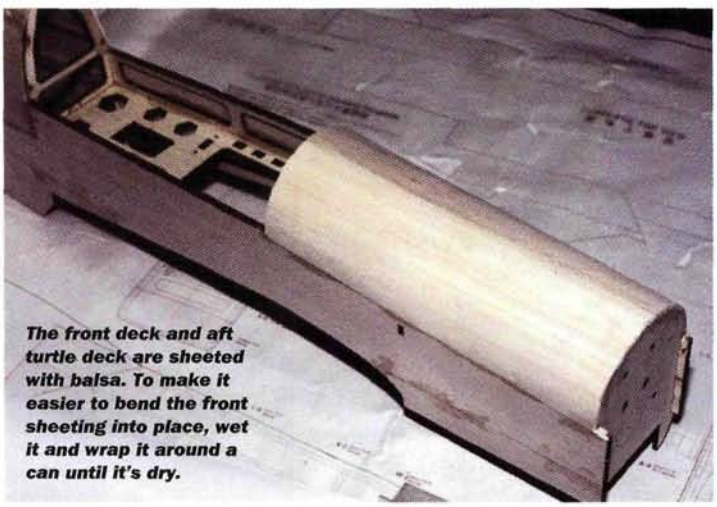
KIT CONTENTS

The Seduction Free Style kit consists mainly of extremely high-quality balsa and ply parts, all of which are precisely laser-cut, and three sheets of plans. The package also includes a one-piece clear plastic cowl, wheel pants, a clear canopy and a nylon engine mount that's designed specifically to allow you to mount the engine inverted. Of course, the Seduction also comes with instructions and safety guidelines, and a note of revision that concerns the center of gravity (CG). Pay close attention to the new location given; it will be very important when it comes time for the first flight.

The supplied plans come as three sheets: the first illustrates the building sequence; the second includes the fuselage top and side view and a template for gluing the fuselage's side panel; and the third sheet details the wing and stabilizer top view. (Note: only the right wing is shown on the plans; to build the left wing, simply flip the plans over and apply a light coat of oil or silicon spray to bring out the images from the front of the plans.)

The highly detailed and informative plans also feature a parts list and illustrated drawings of the ply planking, the tail group, the fuselage sides and the ribs. Be sure to take some time to familiarize yourself with the plans and identify all the necessary parts of the plane before you proceed.

What's most surprising about this kit is what isn't included: decals. With a little investigation, however, I was able to locate a website from which the appropriate graphics can be downloaded. The site (www.sannet.ne.jp/okmodel) is in Japanese, but enough can be understood to get what you need.



The front deck and aft turtle deck are sheeted with balsa. To make it easier to bend the front sheeting into place, wet it and wrap it around a can until it's dry.

Following the recommended guidelines, I decided to use an Enya Super Sport .40 with a TN carburetor and an APC 10x7 prop for power. An Airtronics Radiant 6-channel radio system and five Airtronics servos provide control.

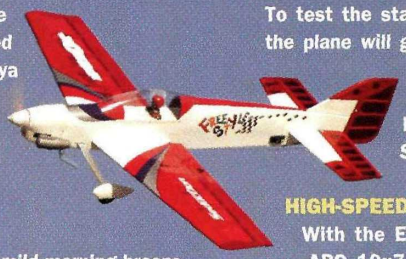
CONSTRUCTION

Fuselage. Start construction by assembling the two fuselage sides, which are comprised of five laser-cut pieces each. Cover the plan with wax paper; then glue the interlocking pieces together (I used thin CA throughout the construction). To speed up the construction process, you can assemble both sides at the same time. Lay out the side doubler pieces before you glue them into place. Be sure to build a left and a right fuselage-side assembly and to glue all the servo cutout doublers and the balsa strips along the bottom edges of the fuselage's sides.

Assemble the firewall parts and install the blind nuts for the engine mount. The fuselage formers have interlocking assembly tabs on their sides that match up to slots cut into the fuselage sides. For proper alignment, be sure to glue all the parts together correctly. Next, glue the balsa stringers into place to

FLIGHT PERFORMANCE

As with any new model, always make sure that the engine is properly broken in and tuned before the first flight. Setting the inverted Enya .40's needle valve for a smooth transition requires a little time and patience. I set the idle slightly high so that the engine would run comfortably.



TAKEOFF AND LANDING

On the first flight, I pointed the plane into the mild morning breeze, advanced the throttle modestly and applied a little backpressure to the elevator. The Seduction didn't require any rudder input; it tracked straight down the runway and lifted off in about 50 to 70 feet. The Seduction tracks well at full power; it's extremely agile and responsive to all inputs and didn't require any trim adjustments on the first flight.

After a couple of passes down the runway, I was ready to land. I simply set the model up on final approach, reduced power to ¾ throttle and then to idle. The Seduction settled in for a perfect 3-point landing. At just 74 ounces, the Seduction lands better than most trainers; spot landings are a breeze.

LOW-SPEED PERFORMANCE

The Seduction slows down very nicely and remains both controllable and stable at low speeds. It shows no bad habits such as tip-stalling. To test the stall, I simply point the nose up slightly until it stalls; the plane will give you plenty of warning before it does so. When it does stall, the right wing falls first, which is quite a mild reaction for a plane of this size. To recover, just hit throttle and point the nose down a bit; the Seduction bounces back nicely without any surprises.

HIGH-SPEED PERFORMANCE

With the Enya Super Sport .40 well broken in and turning an APC 10x7 prop, the Seduction is capable of fairly impressive speeds. At full throttle, the plane tracks straight, but because of its large control surfaces, the Seduction is a bit sensitive and light on the sticks. Setting the Seduction up with dual rates will help smooth things out at high speeds.

AEROBATICS

Loops, rolls, flat spins—you name it, the Seduction can do it. It's capable of just about any 3D aerobatic maneuver you can think of. With the large control surfaces and plenty of throw, the Seduction can maintain knife-edge flight for as long as its pilot can. It rolls on a rail without any tendency to barrel over.

The plans provide recommended throws and setups for both normal and 3D flight. It's best to set the rates for both; use the high rates for 3D maneuvers and the low rates for normal flight. I don't recommend that you take off on high rates—use the low rates until you're airborne!

support the aft turtle-deck sheeting. Using the side profile on the plans as a guide, cut the top sheeting to the approximate size and glue it into place. Once the glue has dried, trim and sand the sheeting flush with the top edge of the fuselage sides. Glue the top pieces to the turtle deck, and then trim and sand them to shape to finish the structure.

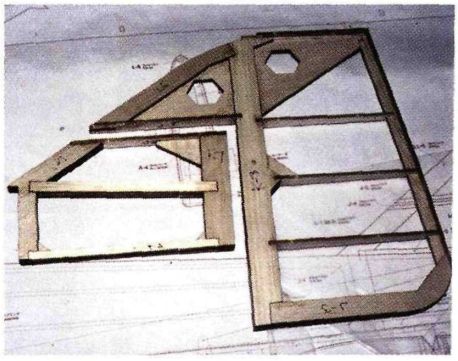
To make it easier to bend the top front fuselage sheeting, wet it lightly with glass cleaner, wrap it around a can and hold it in place with rubber bands. When the wood has dried, glue the sheeting into place with CA. The bottom of the nose is shaped out of balsa blocks that are formed by laminating several balsa parts together. After you've glued the blocks into place, carve and sand them to shape using the bottom of the firewall as a guide.

Horizontal stabilizer. You have two options for tail-group construction: the sport version and the 3D freestyle version. The freestyle version uses a built-up structure with airfoil-shape ribs, and the simpler sport version uses a solid, flat balsa stabilizer; I chose to build the freestyle version.

After you have built the stab, glue the tips into place; then trim and sand the structure so everything blends smoothly. Cut off the elevator halves and install the balsa triangle stock to both of the elevators' leading edges and the stabilizer's trailing edge. Fit the stab into its slot, and trim it if necessary for a good fit. Cut a small opening in the fuselage to allow the elevator-joiner wire to pass through it. It's best to install the elevator joiner after you have covered your model.

Vertical fin and rudder. Gather all the necessary parts before you begin construction. Lay everything out and test-fit the parts before you glue them together. Mark the hinge location, cut slots and test-fit the rudder to the fin. After you've assembled the fin and the rudder, shape, sand and smooth both assemblies so they fit together nicely. Glue the fin to the fuselage, add the support blocks and carve them to shape so they blend into the aft turtle deck. Hinge the control surfaces

Each wing panel is built flat on the building board and then joined after each has been assembled. Note that all of the parts are laser-cut and fit nicely together.

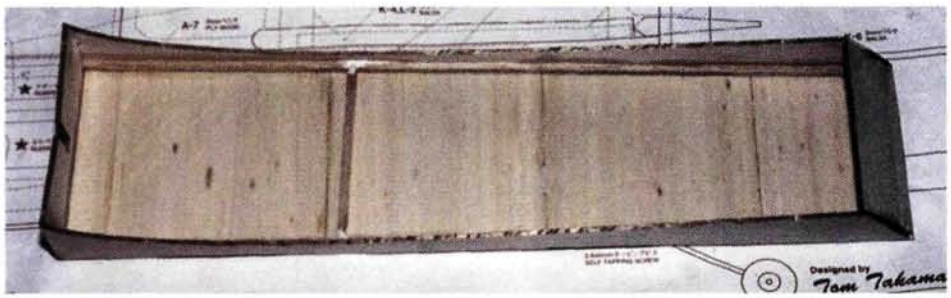


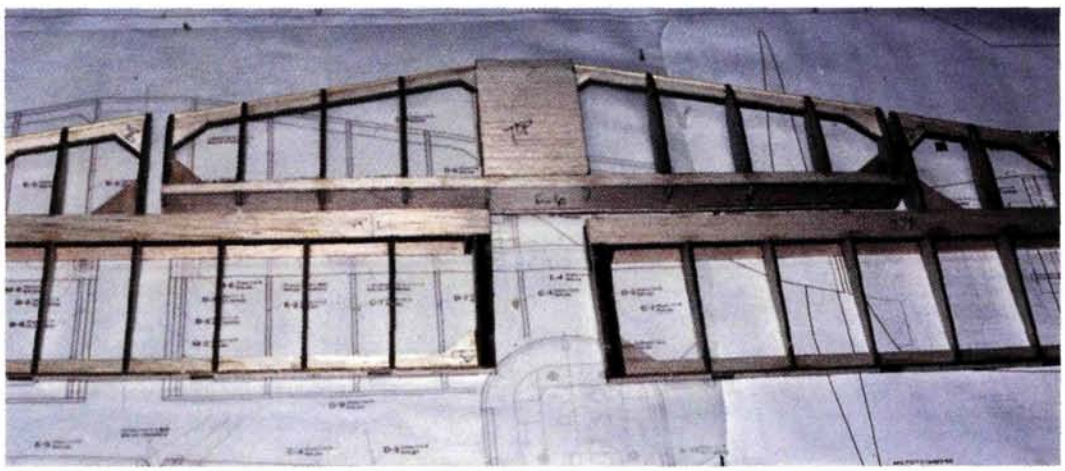
The vertical fin and rudder are also made using laser-cut parts.

together, but don't glue the hinges into place until everything has been covered.

Wing. Cover the plans with wax paper then lay out all the ribs, the spar parts, servo trays and sheeting that you need to build each wing panel. Start construction with ribs C-2 and E-6 and the wing spars D-1 and C-1, and then install the eight remaining ribs. Make sure that all the ribs are pinned flat onto the building board and are standing vertical. Insert the servo mounts between ribs E-6 and D-5. Set the top spars in the rib notches and glue them into place. Remove the panel from the building board and check that everything has been glued together properly. Trim and sand the balsa leading and trailing edges flush with the ribs; then edge-glue two balsa sheets together to form the wing sheeting. Cut it to shape as shown on the plans.

The Seduction Free Style is perfect for both the Sunday flier and the all-out adrenaline junkie.





Above: the belly pan is easy to assemble and can be fitted and glued to the wing before or after the plane is covered. Right: when it's time to build the horizontal stabil-izer, you can choose to build either the sport version or the 3D version. I chose the 3D version that features a built-up structure with airfoil-shape ribs.

Place the wing back on the building board and glue the top sheet into place. Glue the tapered balsa block into the wing between ribs C-8 and D-8 on the trailing edge; next, remove all the building tabs from the ribs and sand the ribs smooth. Sheet the bottom of the panel in the same way as the top. Trim away a portion of rib D-8 to clear the wing joiner, then finish the wing sheeting. Trim the leading-edge sheeting flush with the front of the wing, then glue the leading-edge strip into place. Sand the leading edge smooth so it blends into the sheeting.

Cut and glue the capstrips to the ribs, and then glue the wingtip into place. Install the aileron by cutting the hinge slots; make sure that all the slots are straight and that the aileron's movement is unrestricted. Trim rib C-8 to clear the wing joiner, then glue the wing-joiner pieces together and epoxy it into place. Epoxy center ribs B-1 and K-7 to the wing root. Build the second panel as you did the first, and then join the wing panels. Make sure that you achieve the proper dihedral angle as shown on the plans.

Belly-pan assembly. Glue the belly-pan parts together and reinforce the bottom of the pan with balsa strips. Cut the cross-grain sheeting to size, and glue it to the bottom of the belly pan. Position the wing on the fuselage then glue the plywood wing-bolt plate to the wing. Drill holes in the wing for the mounting bolts at a right angle to the bottom surface of the wing. Place wax paper between the wing and the fuselage, and then bolt the wing into place so you can test-fit the belly pan. When you're satisfied with the fit, glue the pan to the wing.

WRAPPING IT UP

Once the airframe is complete, it's time to cover the model. I covered my Seduction with transparent red and opaque white MonoKote to mimic the color scheme pictured on the box. I downloaded the files for the decals and the logo, traced the images onto MonoKote, cut them out and placed them on the model, using the picture on the box as a reference.

After I had covered the model, I installed the canopy. Follow the outline indicated and cut the canopy to shape; then test-fit and install it. I added a 3mm balsa shelf to the cockpit area to serve as a mount for a pilot figure.

Like the canopy, the cowl is made of clear plastic, so it's easy to locate the cutouts for the engine and muffler. Once you've made all the necessary cutouts, paint the cowl to match the MonoKote on the rest of the model. Attach the wheels and wheel pants on the main landing gear with the supplied screws, washers and nuts.

I built the rest of the model as instructed and installed the battery and radio gear where specified in the plans. The final step is to balance the model; the CG should correspond to the location given in the revision note. Set your radio throws and dual rates according to those provided for 3D flight.

CONCLUSION

Anyone with a little building experience will be able to build the Seduction in just a few weeks. The Seduction Free Style features a lightweight and well-built design, and it's perfect for both the Sunday flier and the all-out, 3D adrenaline junkie. In fact, this plane's abilities are limited only by those of its pilot. ✈

Airtronics *(714) 978-1895; airtronics.net.*

APC Props; *distributed by Landing Products (530) 661-0399; apcprop.com.*

Enya; *distributed by MRC.*

MonoKote; *distributed by Great Planes Model Distributors (217) 398-6300; (800) 682-8948; greatplanes.com.*

MRC *(732) 225-2100; modelrectifier.com.*

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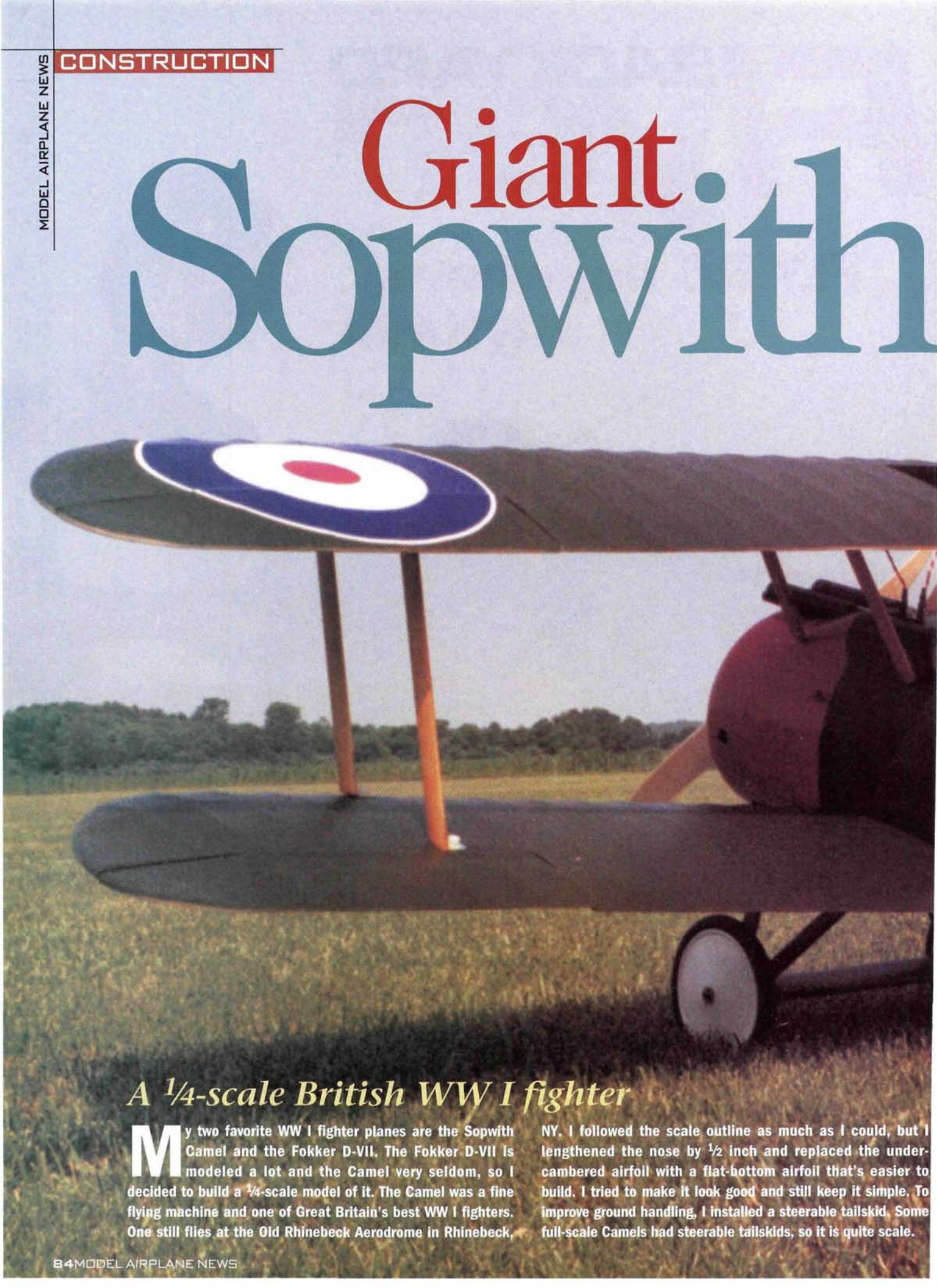
Giant Sopwith



A ¼-scale British WW I fighter

My two favorite WW I fighter planes are the Sopwith Camel and the Fokker D-VII. The Fokker D-VII is modeled a lot and the Camel very seldom, so I decided to build a ¼-scale model of it. The Camel was a fine flying machine and one of Great Britain's best WW I fighters. One still flies at the Old Rhinebeck Aerodrome in Rhinebeck, NY. I followed the scale outline as much as I could, but I lengthened the nose by ½ inch and replaced the under-cambered airfoil with a flat-bottom airfoil that's easier to build. I tried to make it look good and still keep it simple. To improve ground handling, I installed a steerable tailskid. Some full-scale Camels had steerable tailskids, so it is quite scale.

Camel

by John Tanzer

Photos by John Tanzer.

The upper-wing parts have been cut out and are ready to start construction.

SPECIFICATIONS

MODEL: Sopwith Camel

TYPE: scale WW I British fighter (biplane)

WINGSPAN: 77 in.

LENGTH: 50 in.

WEIGHT: 18 lb.

WING AREA: 1,848 sq. in.

WING LOADING: 21 oz./sq. ft.

AIRFOIL: flat bottom

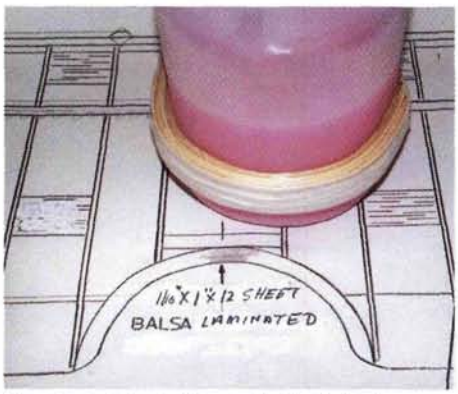
RADIO: 4-channel (rudder, elevator, ailerons, throttle)

ENGINE USED: Quadra 40cc

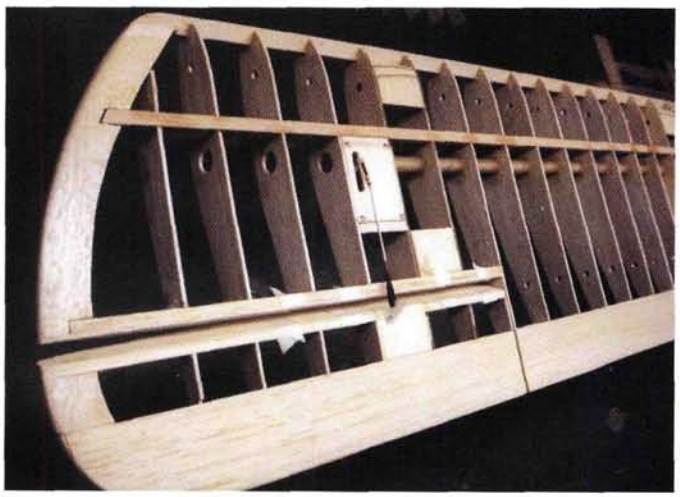
COMMENTS: Designed by John Tanzer, the Sopwith Camel is not difficult to build, and assembly at the field is very easy. Both wings are one piece; there aren't any flying wires to contend with. The Camel has a very short nose, so you should keep all weight as far forward as possible. Even so, I had to add 16 ounces up front, bringing the all-up weight to 18 pounds—still light for its size.

CONSTRUCTION

Wing. Cut out the main ribs from ⅛-inch balsa sheet; I used the stack method. Make the lower-wing center ribs out of ½-inch balsa. Make the vertical-grain shear webs from ⅛-inch sheet balsa. To make the upper wing's half-round cutout structure, laminate pieces of 1/16-inch balsa strips together using a 1-gallon plastic jug as a form. Make the wingtips from ⅜-inch sheet balsa. To produce full-length, one-piece top wing spars, splice the material at the center. Make the two lower dihedral braces from aircraft ply.



Above: a 1-gallon jug is used to laminate the upper wing cutout liner. Soak strips of 1/16-inch balsa in water, and then laminate them together with yellow glue. Hold everything together with masking tape until it has dried. Below: the bottom of the top wing shows the aileron installation.



The top wing is built in one piece flat over the plans. Pin the lower spruce spar into place, and use one or two ribs as spacing guides to pin down the sheet-balsa trailing edge. Pin down the balsa aileron spars, and glue all the ribs in place. Install the shear webs now or later. Glue the cutout center piece in place, glue in the ½-inch crosspiece, then cut two ribs to fit and glue them into the wing center section. Slide the aileron servo-wire lead tubes into place, and glue them to each rib. Next, glue on the wingtips, the W-4 tip ribs and the A-1 aileron rib ends. Cut out the ailerons after you've completely built the wing. Now glue in the top spar followed by the balsa leading edge. Cut a rib to fit into the front center section and glue it into place. Glue in all the ¼-inch-plywood strut-mounting blocks. Remove the wing from the building board, round off the leading edge, and cut and sand the center cutout and the wingtips to shape. Sand the wing smooth.

Carefully cut the ailerons from the wing structure. Glue ⅛-inch sheet balsa to the aileron bay face. Cut the aileron leading edge to the angle shown on the plan, then glue on the ⅛-inch sheet balsa. Hinge the aileron at the top after you've covered the wing.

The lower wing is built in two panels using the same method as you did for the top wing, but leave out the last center rib. After the two panels have been built, remove them from the board, and pin into place the spruce bottom center-section spar and the sheet-balsa trailing edge. Cut out the ¼-inch ply dihedral brace, and glue it to the top of the spar beam (I used Zap CA). This will form an I-beam. Pin the ¼-inch-ply landing-gear mount in place; then glue in the ½-inch-thick center ribs. Slice the leading edge in half vertically, and glue one half to the front of the ribs. Cut the front dihedral brace to shape and glue it in place; then glue in the top spar. Now slide the wing panels into place, and block up each of the tips 4 inches. After the glue has dried, remove the wing from the plan, and shape and sand it smooth. Cut out and assemble the bottom ailerons as you did the top ones. Glue an ⅛-inch-ply control-horn mount into each bottom aileron. Make the servo bays in each wing panel to suit your radio gear. I used standard servos on all four ailerons.

Fuselage. Using the pattern on the plans, cut out the two fuselage sides from ⅛-inch lite-ply. Clamp the two sides together, and sand them simultaneously so that they are exactly the same. At the rear, under the horizontal stabilizer, score the inside of the sides about ¼ inch apart to make the lite-ply easier to bend. Glue balsa longerons and uprights to the inner surface of the sides, and then glue on sheet-balsa wing-saddle doublers. Pin down balsa crosspieces to the top view of the plans back to F-4. Place the sides upside-down, and pin and glue them to the cross-

pieces; then glue in the ¼-inch-ply wing dowel mount and the ¼-inch-ply wing bolt plate. Once the glue has dried, pull the rear of the fuselage sides together, and glue in the balsa crosspieces back to station F-7.

Use a wedge-shaped piece of balsa to join the ends of the fuselage sides. Use the top view as a guide, and cut the two ¼-inch balsa crosspieces to shape and glue them into the top and bottom of the fuselage.

With the fuselage still pinned to the work surface, trial-fit the lower wing into the wing saddle. Check that the wing is level by measuring up from the work surface to the wingtips. Drill a ⅜-inch hole through the wing dowel plate and into the leading edge, then glue a ⅜-inch dowel into the wing. Check the wing's alignment by measuring from each tip to the center of the tail. Each measurement should be the same. Drill the wing bolt holes, and drill and thread the bolt plate with a ¼-20 tap. Harden the threads with thin CA.

Cabane and interplane struts. Use the front and side views from the plans as a guide, and bend a left and a right cabane strut from ⅛-inch music wire. Solder tin or brass sheet-metal wing-mounting tabs to the tops of the cabanes, then drill ⅛-inch holes into the longerons at the top of the fuselage to accept the cabanes. Temporarily clamp the cabane wires to the fuselage sides; then with the top wing placed upside-down on the workbench, lay the fuselage and struts on top of the strut-mounting blocks. Once you have properly aligned the wing with the fuselage, drill through the mounting tabs and into the wing-attachment blocks. Remove the fuselage from the wing, then drill and thread the plywood mounting plates with a ¼-20 tap. Reattach the wing to the cabane struts with the ¼-20 plastic wing bolts.

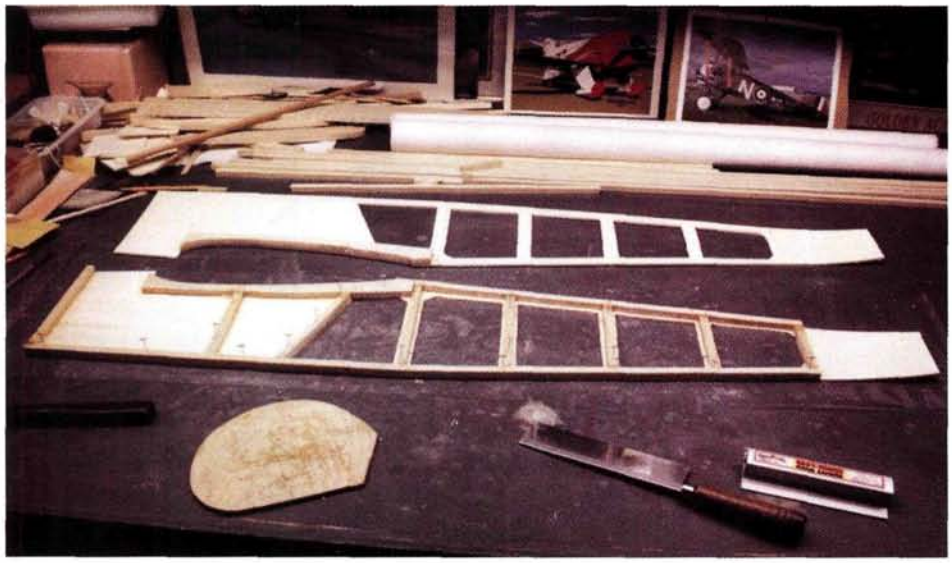
Bolt the lower wing into place, then turn the plane over to check wing incidence. Block the plane up so the lower wing is at 1 degree positive (I use a Robart incidence meter). Adjust the cabane struts so the top wing is at 3 degrees positive, and temporarily clamp the wing into place using scrap balsa braces. Make four cabane fairing caps from 1/16-inch ply and bals, and epoxy them in place over the wires.

Check the distance between the top and bottom wings at the interplane strut-mounting blocks. Clamp a balsa stick to the upper and lower wing ribs to maintain an equal spacing while you install the struts. Using either tin or brass sheet metal, make eight angle brackets and screw them to the attachment blocks with ¼-20 plastic bolts. Make the struts out of ⅜x1-inch spruce or basswood. Cut slits into the strut ends, and slide them into place over the brackets. Glue them to the brackets with epoxy. Remove the struts one at a time, and mark their locations so you can reinstall them in the same place. Trim the metal brackets to shape, and sand the struts to an airfoil shape. Now finish the fuselage by adding the top decking and the side sheeting. Cover the cabane wires with basswood, then sand them to an airfoil shape.

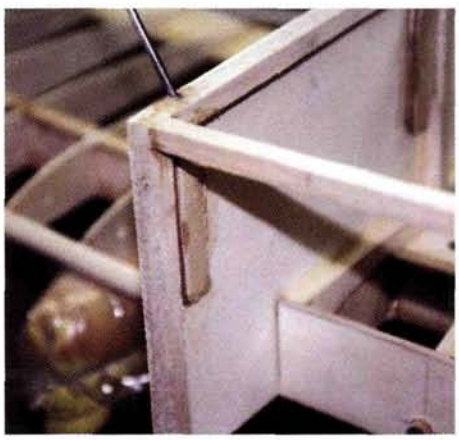
If you like WW I fighter planes, build yourself a Camel.

Cover the fuselage's machine-gun hump with 1/64-inch ply; then make the guns from dowels. Cut slots into the ply sheeting to fit the guns in place.

Tail surfaces. Make the horizontal stabilizer, elevators, fin and rudder from ⅜-inch balsa sheet and ⅜x½-inch balsa stripwood. Dry-fit the control surfaces together with CA hinges; then check their alignment with the wings, and glue the stabilizer and fin to the fuselage. Make the steerable tailskid, and cut a slot in the fuselage for the pivot tube and epoxy it into place (see plans for details).



Left (top): the lite-ply fuselage sides with the ⅜-inch-square balsa uprights and longerons glued in place. On the very end of the fuselage side, score the inner surface about every ¼ inch to make the required sharp bends. Left (bottom): the fuselage is built upside-down on the top view of the plan. Below: note the mounting of the cabane wires: plywood and balsa caps are epoxied to the fuselage sides.



FLIGHT PERFORMANCE

At the field, I ran the Quadra 40 and did a range check; interference from the engine required that I make some changes. I added a Bosch spark-plug metal cover to the spark-plug lead, and that cured my problem.

TAKEOFF AND LANDING

The taxi out and turn into the wind were good; the steerable tailskid helps here. I gave it the throttle, let the tail come up, and the Camel dumped over on its nose. I had let up too soon on the elevator; luckily, I didn't break the prop. On the next try, I held the tail down, and the takeoff was good. The controls proved to be very effective. For smooth, scale turns, I coupled the rudder to the ailerons (just a bit). On the landing approach, I cut the throttle to idle, and with its light wing loading, the glide is very good. A low-pitch prop and low idle are required. It is better to try a 3-point landing; a wheel landing will end in a dump-over if you relax the elevator too soon.

GENERAL FLIGHT CHARACTERICTICS

For such a short-coupled plane, it flies very well and can handle the wind without any trouble. It is best to take off and land into the wind. With aileron differential and coordinated rudder, the turns are very scale-like. The best part is a nice slow low flyby with the old Quadra putting along. Slow flight is great; in fact, it looks best at ½ throttle. At full throttle, it flies too fast to look realistic. I had been flying it with a 22x8 prop, and I think I'll try a 24x8 to get a slower-turning engine. It should sound better and not be so fast.

AEROBATICS

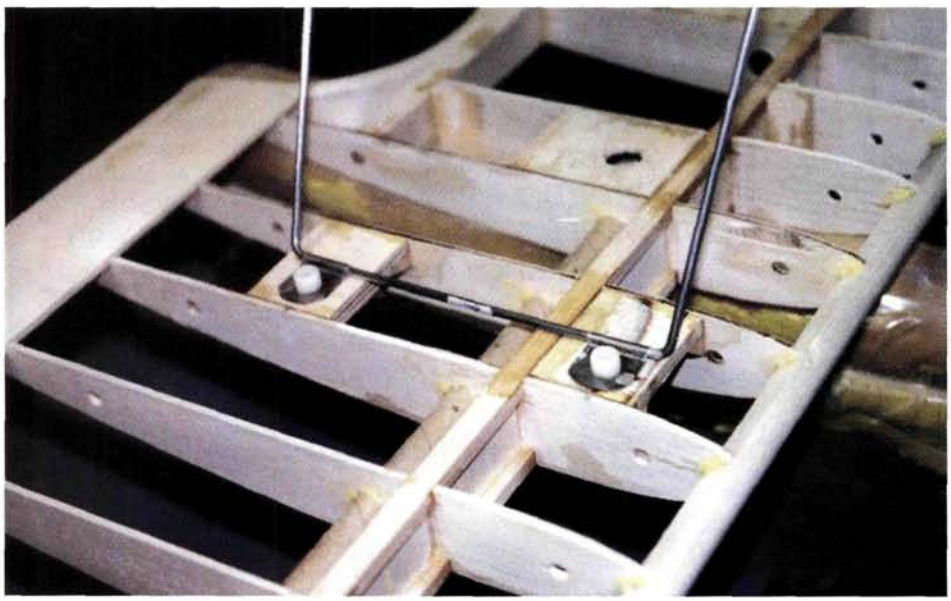
The Camel can do all of the scale WW I-type maneuvers and then some: rolls, loops, wingovers, Immelmanns, chandelles and spins. Also some not so scale-like: inverted flight, knife-edge and a rolling circle. Slow flight is great; the control surfaces work right down to the stall.

Engine and cowl. Before you can install the engine, you must make the cowl. I made mine from fiberglass and resins formed over a foam plug (See "How To Make Fiberglass Parts" in the January 2004 issue of *Model Airplane News*, page 194). Glue four mounting blocks to the front of the fuselage. Make the firewall mount from ⅜-inch ply, as shown on the plans. I used an old Quadra 40 for power, and I set the firewall back into the fuselage to suit the length of my engine. Temporarily clamp the engine to the firewall, and slide it into place; then install the cowl with No. 2 sheet-metal screws. Move the engine and firewall around until the centerline of the prop shaft has 2 degrees of downthrust and 2 degrees right thrust. When you are satisfied that everything is right, tack-glue the firewall into place. Remove the cowl and mix up a batch of epoxy and microballoons, and then glue the firewall permanently into place. Mark the engine-attachment-bolt holes in the firewall, remove the engine, and drill the holes. Reinstall the engine.

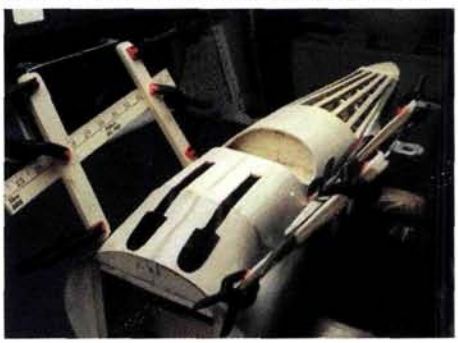
Landing gear. Glue a hardwood block onto each side of the engine, and attach the front landing-gear struts to them. Bend the landing gear from one piece of 5/32-inch music wire, and leave the front open so it clears the engine. Solder a washer onto the open ends of the gear. With the lower wing in place, attach the gear with sheet-metal straps and No. 4 sheet-metal screws in the front and ¼-20 plastic bolts in the rear. The axle is made from ¼-inch music wire and is ½ inch shorter than shown on the plans. Slip a brass tube and two wheel collars onto each end of the axle with ¼ inch of the tube extending out past the end of the wire. Tighten the wheel collars to hold the tubes in place. Solder the axle, wheel collars and brass tubes to the landing-gear wire. Then cross-drill the tube ends to accept the cotter pins and washers that retain the wheels. Cover the landing-gear wire with basswood, and sand to an airfoil shape.

Covering and finish. With a maple stain, varnish the interplane and cabane struts and the landing gear. I covered the model with Sig Koverall and used nitrate dope to seal the weave. I finished the model with butyrate color dope. I painted the cowl and the fuselage front red to match the red in the roundels. I used sign vinyl (from a sign-making store) to make the roundels, tail stripes and letters.

To finish the construction, I installed GWS servos, a JR FM receiver, a large-capacity battery pack and a heavy-duty



Left: check out how the wing-mounting tabs are soldered to the cabane wire. Below: basswood is used to fair in the cabane wires; they're clamped into place until the epoxy has cured.



switch harness. The fuel tank sits in the front section of the engine compartment and is held in place with foam and rubber bands between the receiver and the bottom wing. Be sure to check the balance, and set the CG as I have indicated on the plans. The Camel's wing loading is only 21 ounces per square foot, and it can be flown very slowly. The Quadra 40 engine, swinging a 22x8 Master Airscrew Scimitar prop, is more than enough power. It flies fast enough at only ½ throttle.

If you like WW I fighter planes, build yourself a Camel. Have fun, and fly safe!

GWS; gws.com.tw; distributed by Balsa Products (732) 634-6131; balsapr.com; Horizon Hobby Inc. (800) 338-4639; horizonhobby.com; and Maxx Products (847) 438-2233; maxxprod.com.

JR; distributed by Horizon Hobby Inc. (800) 338-4639; horizonhobby.com.

***Master Airscrew;** distributed by Windsor Propeller Co. (916) 631-8385; masterairscrew.com.*

***Quadra-Aerrow Inc.** (613) 264-0010; quadraaerrow.com.*

***Sig Mfg. Co. Inc.** (800) 247-5008; (515) 623-5154; sigmfg.com.*

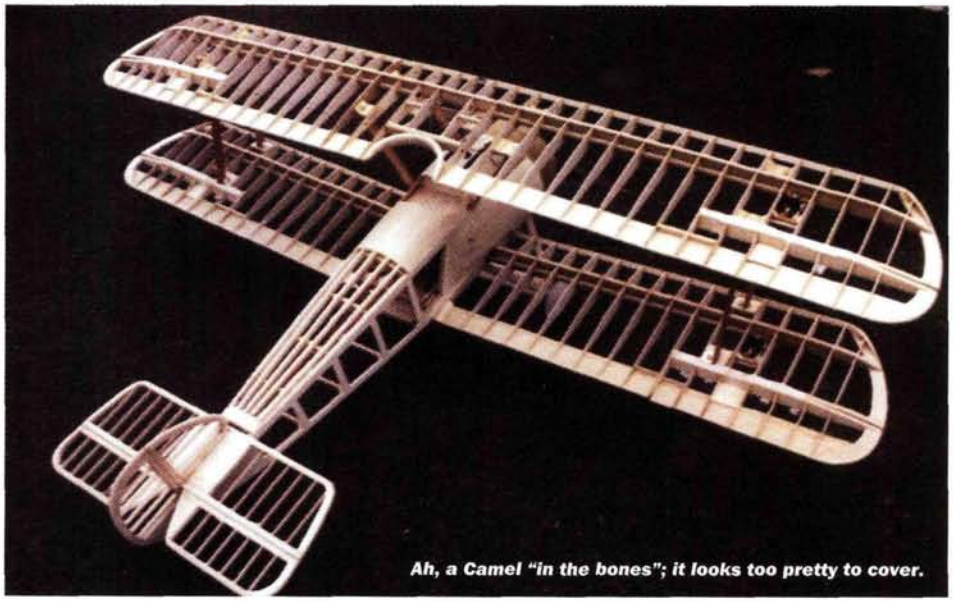
***Zap;** distributed by Pacer Technology (800) 538-3091; pacertechnology.com.*

¼-SCALE SOPWITH CAMEL
FSP0304A

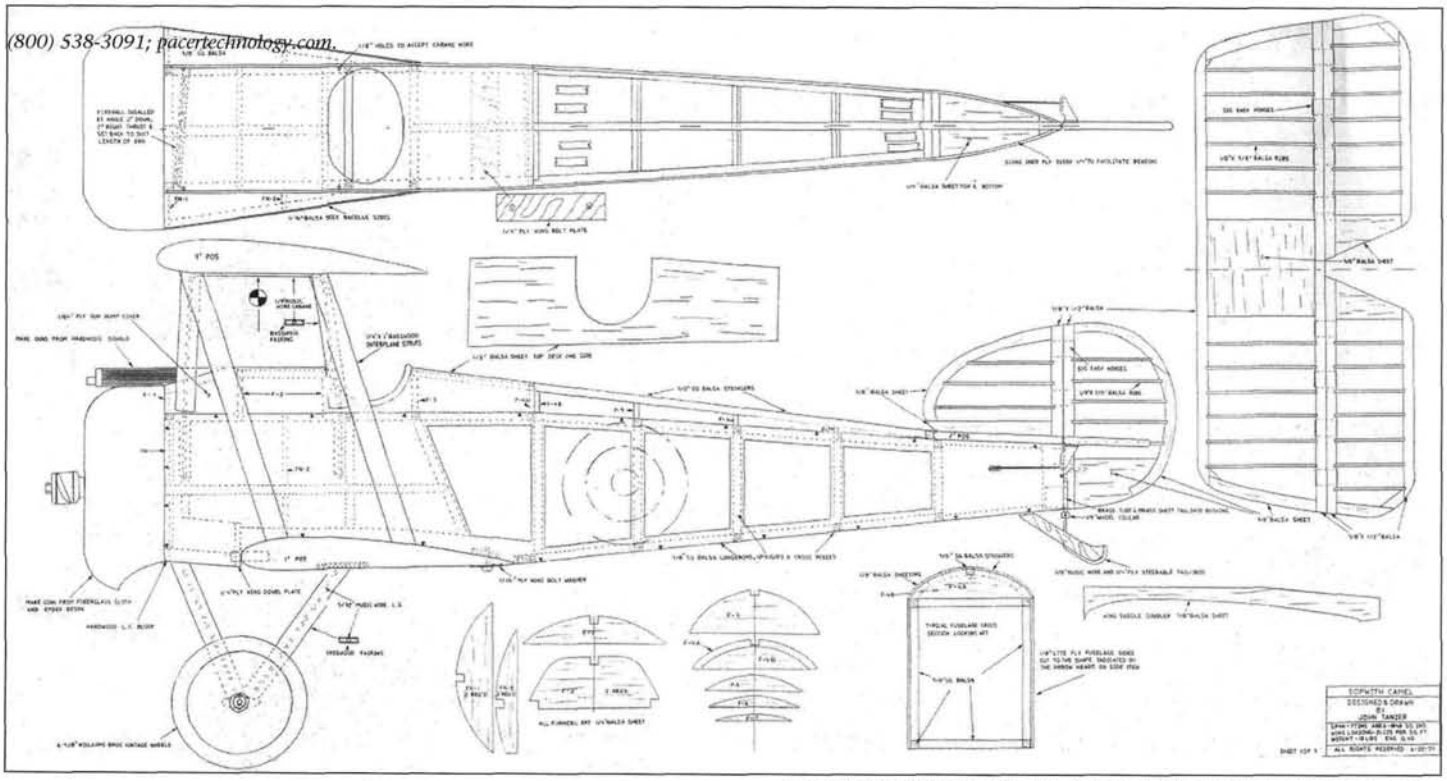
Designed by John Tanzer, the Sopwith Camel uses conventional balsa and ply construction and is not difficult to build, and assembly at the field is very easy; both wings are one piece and there aren't any pesky flying wires to contend with.

WS: 77 in.; L: 50 in.; W: 18 lb.; engine: 40cc gasoline; radio: 4-channel; 3 sheets; LD 2; $21.95

The steerable tailskid; the ¼-inch plywood outer piece is stained and varnished.

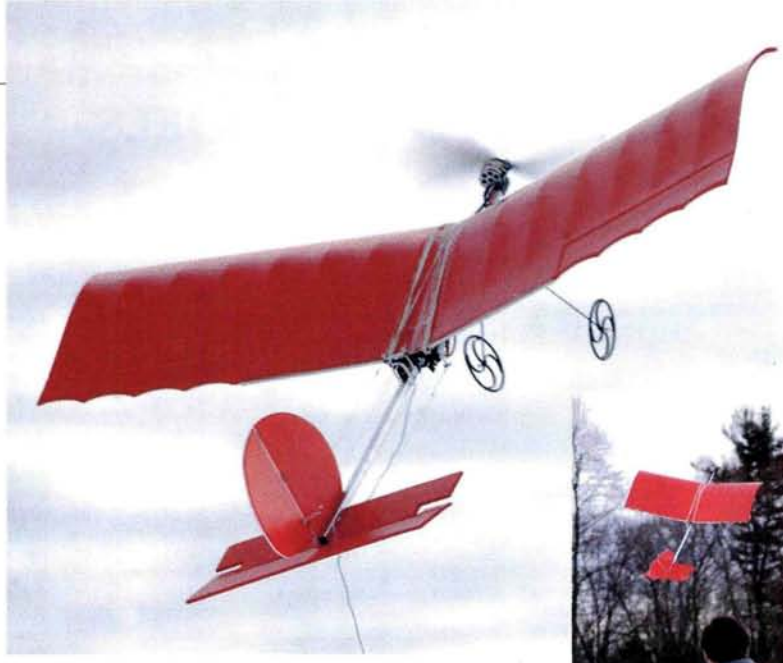


Ah, a Camel "in the bones"; it looks too pretty to cover.



To order the full-size plan, turn to page 154, or visit rcstore.com online.

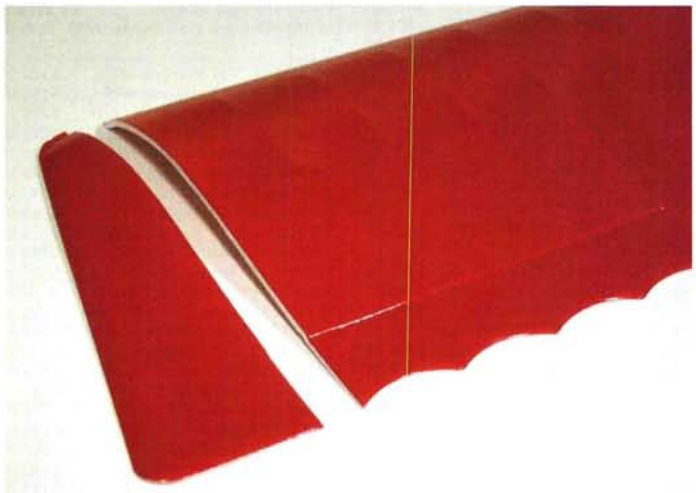
Take your Slow Stick from mild to wild!



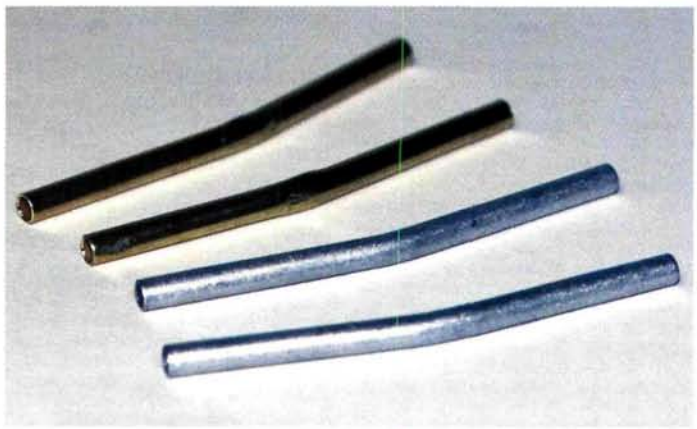
The GWS Slow Stick is an amazing park flyer; it can be assembled quickly and easily, it flies well, and it's very affordable. It has also introduced many fledgling and experienced pilots to the world of park flying. I've been flying a stock Slow Stick for about a year now, and I love that when I have a couple of charged batteries on hand, I can enjoy some easy, relaxing flight time during my lunch break. This is just one of the Slow Stick's virtues. Lately, though, I've felt that improving the model's performance would allow me to fly it in less than ideal wind conditions.

Enter the 2003 Northeast Electric Aircraft Technology (NEAT) Fair. During this annual event, I noticed a highly modified Slow Stick being flown by Kody Knudtson, and he was having a ball with it. Its performance was outstanding and just what I was looking for.

After talking with him for several minutes, I decided that when I returned home, I would modify a new Slow Stick kit that I had. Interested? Follow along as I transform a good park flyer into one with unbelievable performance.



I shortened the Slow Stick's wingspan by cutting off the wingtips at the last "rib."



The kit-supplied wing-brace tubes are made of aluminum and can easily be broken during stressful maneuvers. Replacing them with stronger brass tubes takes only a few minutes; I haven't broken them yet, despite my best efforts!

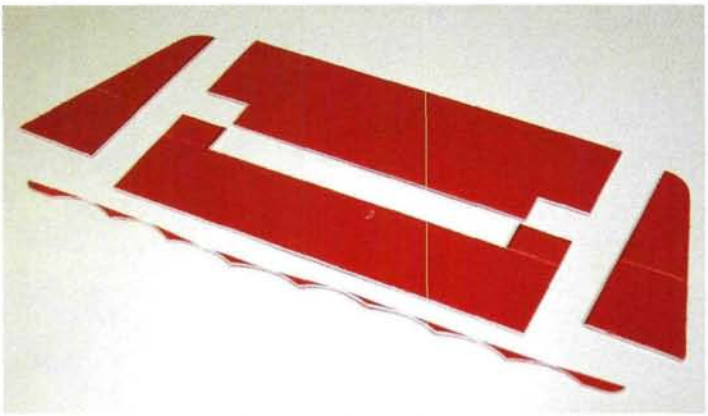
THE METAMORPHOSIS

Modifying the Slow Stick turned out to be rather simple; I did it in three stages: the flying surfaces, the power system and the control system. Each of these mods can be accomplished in steps or—for maximum performance—do them all at the same time. That's what I recommend.

• **Flying surfaces.** To improve the flight characteristics, I first shortened the wingspan. This removes some of the model's tendency to float without sacrificing stability. Several inches of span can easily be removed by cutting off the wingtips at the very last "rib." When you cut foam, always use a new blade so you don't tear the foam.

To reinforce the center section, I smeared on a little 5-minute epoxy instead of the supplied clear tape. It's stronger and cleans up the wing's appearance.

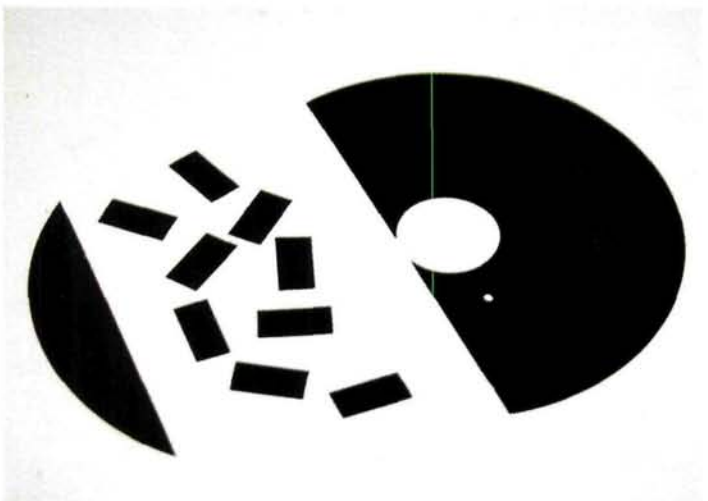
The Slow Stick's one-piece foam wing is molded with a live hinge in the center, and it has to be taped at the hinge for strength. Instead of doing that, I smeared a little 5-minute epoxy onto the joint and glued the wing panels together.



Here's the modified stabilizer ready for hinging. See the text for dimensions.

This eliminates the need for the tape and makes for a neater-looking wing. The wing also has two aluminum tubes that mate with fiberglass rods to stiffen its leading and trailing edges. The tubes are rather soft, and mine have snapped during aggressive maneuvers. A simple fix is to replace them with brass tubes of the same size. I cut pieces of K&S 3/16-inch i.d. brass tube to the proper lengths and then bent them to give the wing its dihedral angle. To date, the brass replacements haven't failed.

Next, I changed the shape of the stabilizer and decreased its size. I shortened its span from 16¼ to 12¼ inches and added counterbalances to the elevator. I cut the counterbalances out of the stabilizer and glued them to the elevator with foam-safe glue. This one little change dramatically increased the elevator's



Old 5¼ floppy discs make excellent hinges for park flyers. They're tough, flexible and free!

effectiveness. I also removed the molded-in scallops for a cleaner look and reshaped the bottom of the rudder to make clearance for the extreme elevator throw I planned to use.

The last modification is the hinging of the control surfaces. The supplied hinge tape is adequate for normal flying, but it isn't suitable for the demands that a high-performance model would place on it. I had to find a suitable replacement. While doing some housecleaning, I ran across a stack of old 5¼-inch floppy discs that I was going to throw away. Remembering that "floppies" are made of a thin, Mylar-type material, I cut open the disc's jacket and removed the floppy. Bingo! It's the perfect hinge material for park flyers—tough, flexible and free. I simply cut the floppy into 3/8x3/4 strips and used 5-minute epoxy to secure them in the flying surfaces. A sharp hobby blade quickly cuts hinge slots in the thin foam. I also beveled the rudder and elevator leading edges for maximum control throw.

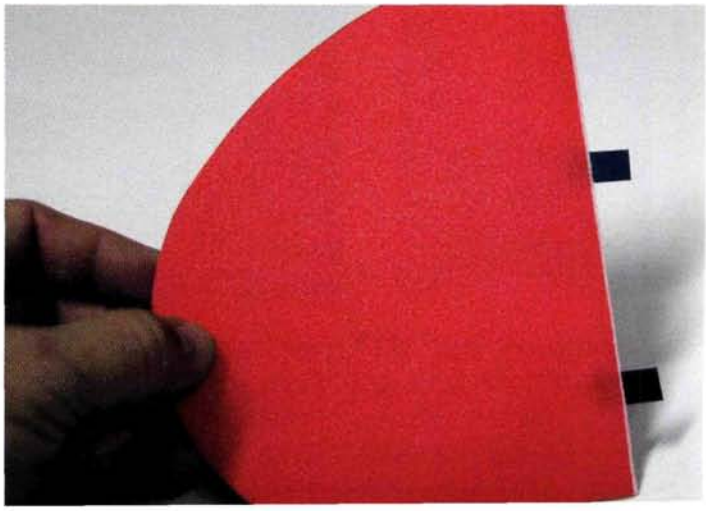
• **The control system.** Now that the flying surfaces were set, I needed a way to move them with no slop or binding and the solution came in the form of Du-Bro's Micro Pull-Pull system (item no. 846). The battery I planned to use is larger and heavier than the stock 7-cell NiMH, so I moved the servos rearward to counter the increased weight. The rudder servo is mounted directly behind

Use a sharp, pointed no. 11 X-Acto blade to make the hinge slots in the control surfaces.

the wing. A piece of double-sided tape and a zip-tie secure the servo. For the elevator servo, I used the supplied servo mount; I turned it 90 degrees and cut off the upper supports, as they interfered with the wing. The lower supports place the servo in a direct line with the elevator horn. With the servos in place, it took only a few minutes to rig the pull-pull cables. The benefits of using a pull-pull system are that it's adjustable and weighs almost nothing.

• **The power system.** The heart of any flying model is its power

The hinges are secured with a dab of 5-minute epoxy. Unlike CA hinges, these are glued to the flying surfaces first. Let the glue cure and add the control surfaces.



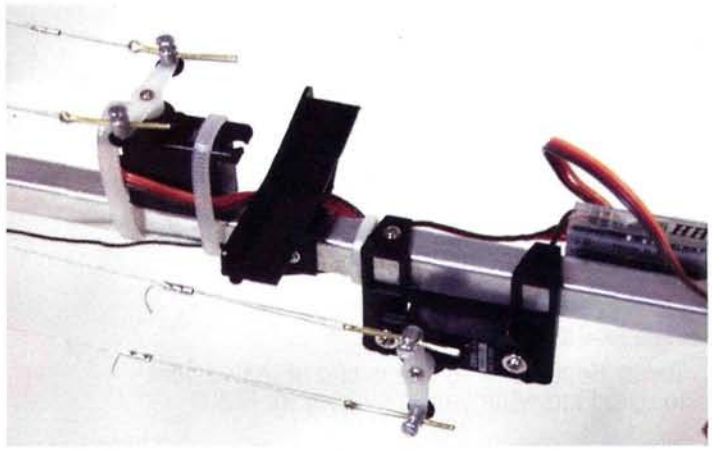
GWS makes this handy Speed 400 motor mount that I got from e-flightline. The mount replaces the kit-supplied one; it just slides onto the fuselage tube.

system. The motor needs to produce ample power and to be efficient and as light as possible. The same can be said for the battery that powers the motor. To handle this task, I used a brushless Mega 16/7/8 motor (geared 2.8:1) that I got from Mega Motor USA, a Kokam 11.1V 2400mAh Li-poly battery from e-flightline and a Castle Creations Phoenix 25A ESC. Mounting the motor and gearbox proved to be simple, as GWS makes a motor mount for Speed 400-size motors (item no. EMM-400T); it replaces the kit's mount. I also replaced the stock GWS propeller with an APC 11x4.7 slow-flyer prop. With all of the components installed, it was time to go flying!

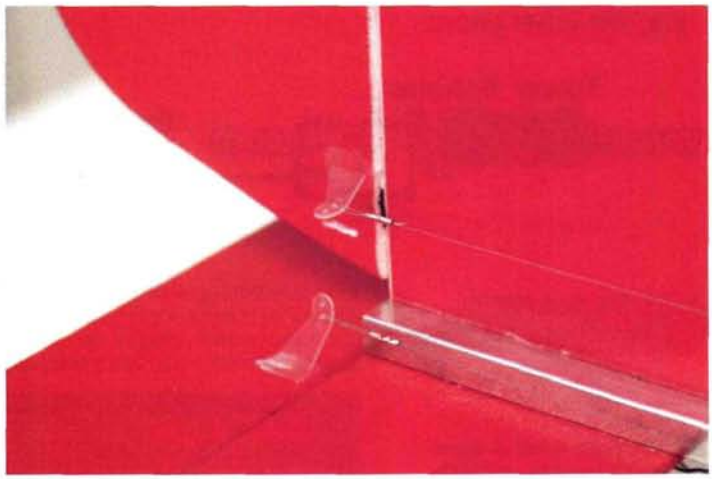
A tightly wound rubber band secures the geared motor on the mount.

IT'S FUN TIME!

When I flew the modified Slow Stick, the conditions were less than perfect. The wind was gusting at 5 to 10mph—stronger than I would usually fly a Slow Stick in. From the moment that I pushed the throttle stick forward, I knew that I had a winner; the model jumped off the ground in less than 1 foot! Given the strength of the wind, control authority was great. I was able to fly the model precisely where I wanted it to go, and its maneuverability was awesome. Power was unbelievable. The Slow Stick climbed vertically without blinking an eye and almost turned



I installed the rudder servo behind the wing, and the elevator servo is under its trailing edge; I turned it sideways 90 degrees. Du-Bro Micro Pull-Pull cables are perfect for this application.



Here are the pull-pull cables attached to the control surfaces. They provide very positive control response and weigh next to nothing.

on a dime. 3D hovering was possible because of its excessive power-to-weight ratio and greater control authority.

Some of you might ask: why put this much effort, time and expense into such a simple model? Well, if you want a model that has gobs of reserve power and handles well in less-than-ideal conditions and is virtually maintenance-free, then this could be the ultimate, simple, high-performance backyard flyer for you! The nice thing about using this power system is that it's a drop-in hop-up for any of the GWS warbirds. Stay tuned!

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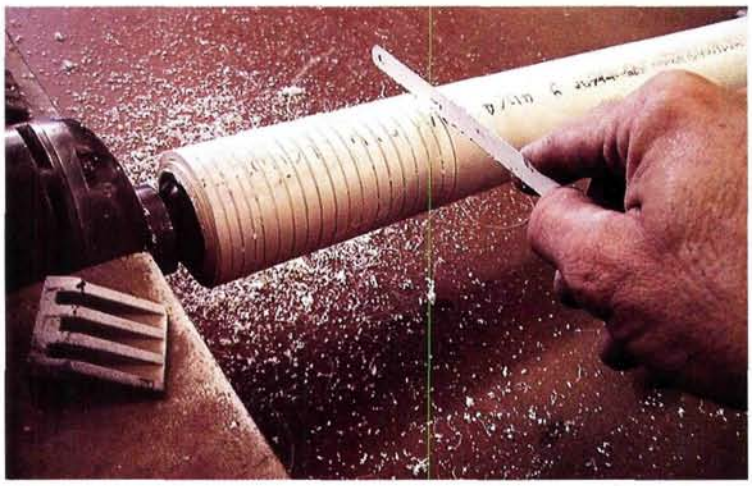
Make Spoked Wheels

Cheap and easy scale secret

by Keith Sparks

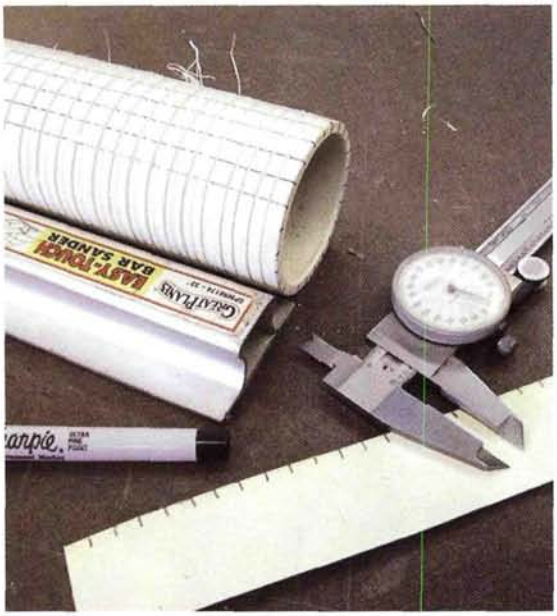
Much has been written about how to create spoked wheels. The problem with most methods is that they require extensive trim work, and the result is often limited in strength. So when I need a set of scale wheels for one of my park flyers, I construct my own using PVC pipe. It's tough, cheap, easy to work with and comes in many sizes.

A well-stocked hardware store will have most of the parts you'll need for this project, with the exception of the threading fixture; you'll have to make that yourself. The absence of dimensions is intentional here. It's more important to keep things simple and to allow your own personal preferences to prevail. With that said, here are the basic steps involved in creating your own inexpensive spoked wheels.

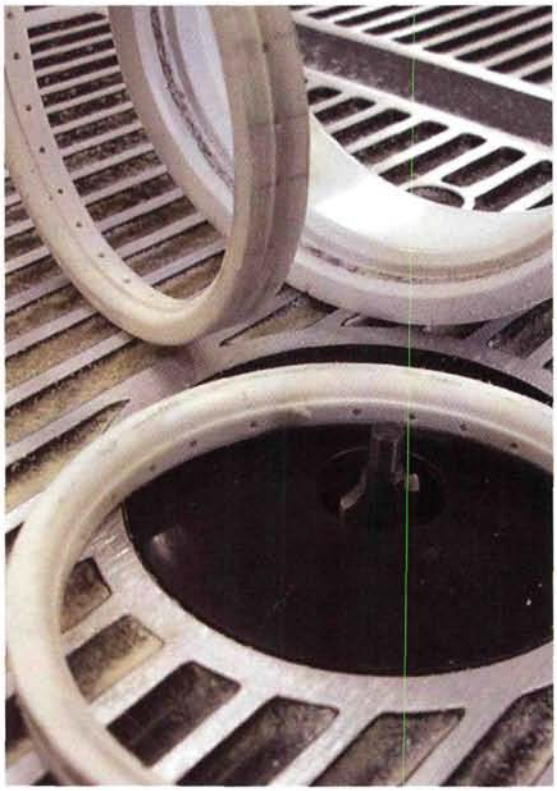


1 Mount a hole saw on a hand drill and wrap enough masking tape around the saw so it fits tightly inside the PVC pipe. Mount the pipe on the saw, then turn the hand drill on to rotate the pipe, allowing you to make evenly spaced scratches in the pipe. A divider works well for this, but it isn't necessary. Next, use a hacksaw blade to cut slots in the pipe to form the individual rims. (Note: do not use a pipe that is longer than 6 inches; it would require support at the other end.)

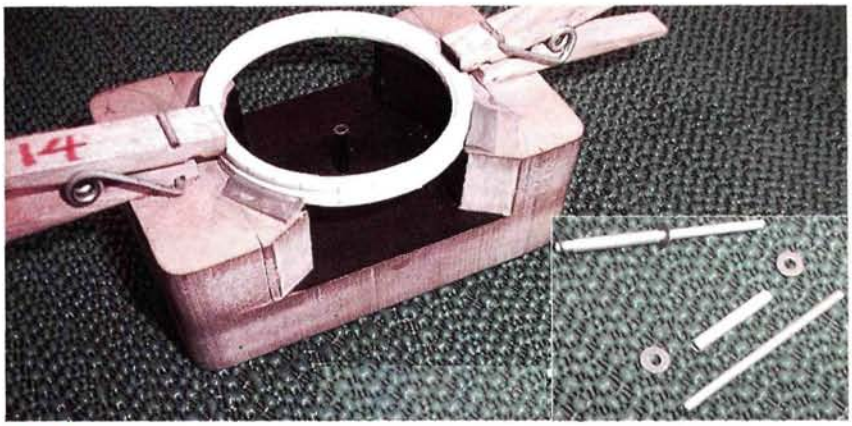
2 For the finished wheel to look right, the spoke holes should be centered. A slight groove helps to keep the drill bit centered and will later serve as a guide for the thread. Use the corner edge of a small file to make the "V" grooves.



3 To determine the proper locations of the holes for the spokes, wrap a piece of card stock once around the pipe, and then trim it to size. Lay the card stock flat on a table, and make 28 evenly spaced marks on the card. Then wrap the card back around the pipe and transfer the marks to the end of the pipe. Drill the holes where the lines intersect the "V" groove. (Note: nest the pipe against the handle of a sanding bar or anything with a 90-degree angle. This ensures that the lines run parallel to the pipe.) The number of holes can vary from 28, but the total must be divisible by four.

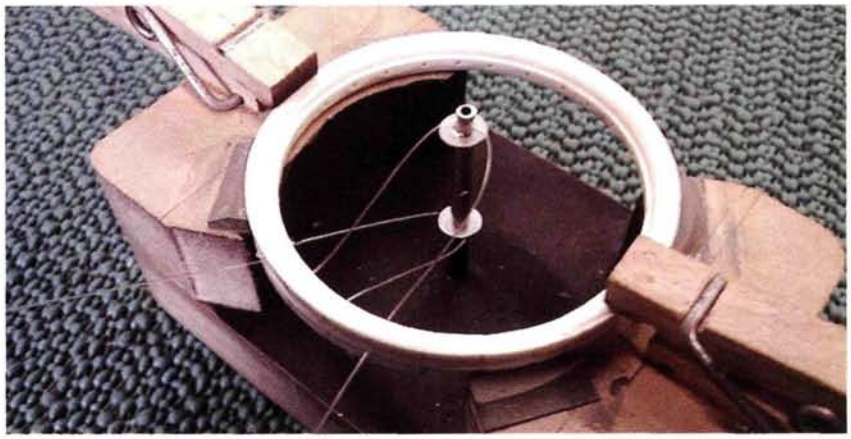


4 After you've drilled the holes, use a saw to separate the rims from each other, and slightly sand the sides. The rims are then ready for the router. Use a PVC fitting to protect your fingers from the router bit while routing the rims' inside radiuses.



5 Use a block of wood to make the threading fixture. Hold the rim centered and squared over the axle post. The clothespins are not required here, but they do come in handy.

The axle hubs are made out of two aluminum tubes and two washers. The hub itself slides over the bearing and is held in place with a light crimp or dent. The washers must be a close fit over the bearing so that they will not slide over the hub. You can then install the whole assembly on the threading fixture by placing it into the axle post.



6 Threading the rim is easier than it looks. I use 8-pound-test monofilament line. Start by making a double knot in the line, then thread it through the first hole in the rim, looping it around the axle post below the washer at the bottom of the axle and out through the third hole in the rim. Pull the line just taut enough to take out the slack. Next, thread the line into the second hole, over the washer at the top of the axle and back out through the fourth hole. That's it! Continue this sequence until you have worked your way around the rim.

7 To set the spoke tension, place the threading tool in your hand, and wrap the excess line around your finger to keep the line tight while you work. Use forceps to tug on the lines leading to the third and fourth holes, and work your way around the rim until all the slack is gone. Next, lay the line into the groove in the rim and apply CA to hold it in place. (Note: if the forceps have "teeth," cover them with masking tape to prevent damage to the line.)

Remove the wheel from the jig and give it a spin test. Any small defects can be fixed at this point. When you are satisfied with the quality of the wheel, use CA to lock down the remaining lines at the rim grooves and at the washers.

8 For your tires, cut strips of foam rubber to match the width and circumference of your wheels. If you have difficulty finding suitable foam rubber for your wheels, you can buy large foam wheels at your hobby shop and cut them to make strips of foam. Cut the strips so that they will fit the rim snugly, and bond the ends of the strips with CA.

9 With the foam in place on the rim, pull back the rubber slightly to expose half of the rim surface. Apply CA to the rim, working around one side and then the other. (A coffee stirrer works well here.)

10 Next, place the extra axle bearing in a Dremel tool or drill and spin it at a low-speed setting; use sandpaper to sand the tire to shape. (Note: if you choose to shape the tire at a high speed, use piano wire through the axle bearing for support, and please use caution.)

11 To cut away the extra axle bearing, place it on the edge of the table and use a razor to roll the bearing. The weak point will enable you to break the excess away.

12 That's really all there is to it! When it comes to scratch-building scale accessories, it really doesn't get much easier than this. And at 0.03 ounce, you will not find a stronger wheel! ✚

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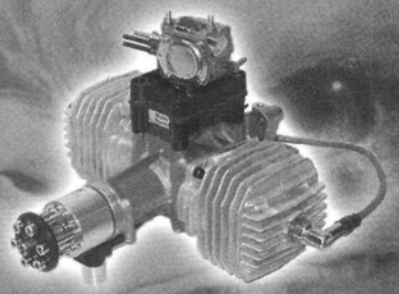

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PRODUCT WATCH

AT *MODEL AIRPLANE NEWS*, we not only tell you what's new, but we also try it out first so we can bring you mini-reviews of the stuff we like best. We're constantly being sent the latest support equipment manufacturers have to offer. If we think a product is good—something special that will make your modeling experiences a little easier or just plain more fun—we'll let you know here. From retracts and hinges to glow starters and videotapes, look for it in "Product Watch."

FUTABA

BR-2000 Battery Checker

Convenient and easy to use

Use the BR-2000 battery checker in your workshop and at the flying field to check or discharge 4-, 5-, or 6-cell Ni-Cd and NiMH battery packs. It features a large, easy-to-read LCD that has numeric and graphic (a gas tank) displays to show voltage. Housed in a sturdy plastic case that has retractable legs, the easy-to-use unit has a "start" button on the front panel. On one side are the discharge-current adjustment dial (1 to 3 amps), the battery-voltage selector (4.8, 6, or 7.2) and the battery connection port. An adjustment screwdriver and a battery connection lead with Futaba connectors are part of the package.

To use the checker, simply select the proper voltage, connect the pack, and press the start button. The voltage will be displayed (red background) for about 20 seconds. To switch to the discharge function, hold the start button down for 3 seconds. The unit's internal cooling fan will start, and the indicator will display the discharge voltage (blue background). To halt the discharge cycle, press the start button again. The unit will automatically stop discharging when the voltage drops to 0.9 volt per cell.

Priced at $39.99, the BR-2000 is very convenient to use, and its display is easy to read, even in direct sunlight. It makes a great addition to any workbench or field box. —*Gerry Yarrish*

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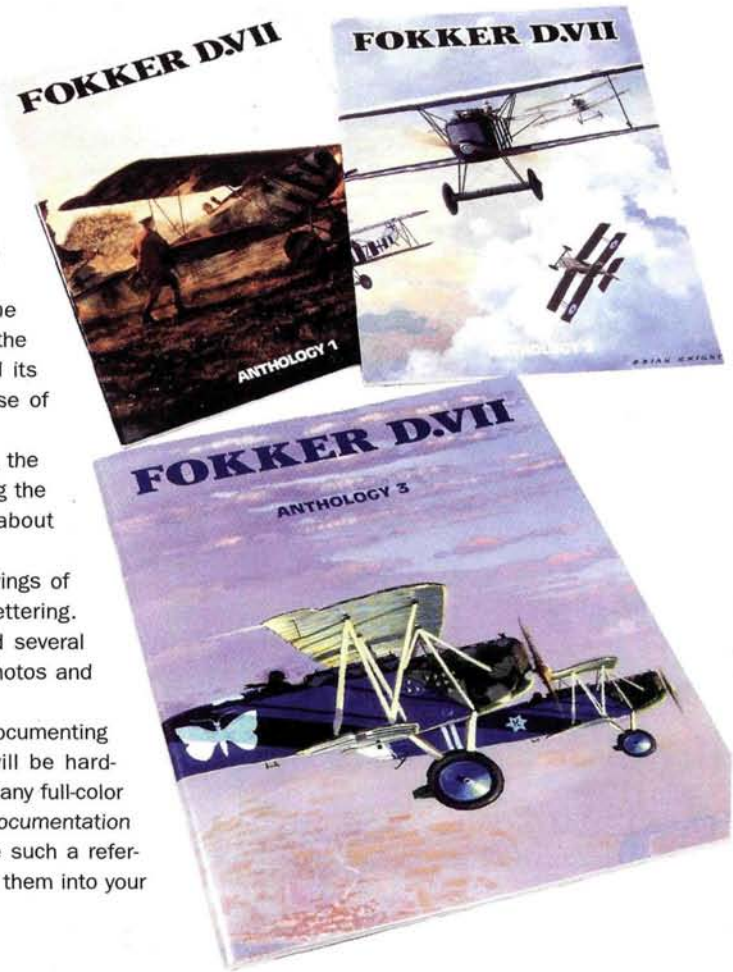
WISE OWL PUBLICATIONS

Fokker D.VII Anthology

Worth its weight in gold

Although much has been written about this classic WW I German fighter, it seems there is always something new to learn about the infamous Fokker D-VII. For scale modelers and historical aviation buffs alike, there is a never-ending search for accurate documentation about this world-famous biplane. Part of the Windsock Datafile Special book series, this anthology comprises three volumes that are filled with detailed information—everything from cockpits and landing gear to armament fittings and internal structures.



Volume 1 ($38) contains more than 130 photos plus 10 airframe sketches and 11, one-side, full-color profiles. It includes chapters on the plane's history, structural details, Fokker standard factory finishes and its many unique *Jasta* (squadron) markings. Detailed drawings include those of stencil and lozenge fabric.

Volume 2 ($40) also has over 130 photos plus 12 color side profiles, the manufacturer's structural details and additional *Jasta* markings (including the famous Ernst Udet D-VII). We're also treated to interesting details about Hollywood movie D-VIIs and wing structure.

Volume 3 ($41) has, as its highlights, accurate multi-view scale drawings of the Albatros D-VII as well as national insignia, crosses and stencil lettering. Scale drawings and photos represent more than 30 German *Jasta* and several German Navy units. The 64-page publication includes more than 120 photos and sketches, over 45 color profiles and five pages of scale drawings.

For scale modelers, these books are a treasure trove that's ideal for documenting any number of the excellent available scale Fokker D-VII kits. You will be hard-pressed to justify painting your model all red once you've reviewed the many full-color renderings! All are exceptionally well reproduced and perfect for any documentation booklet. But don't cut those pages out! It would be a crime to damage such a reference source. Scan and reproduce them on glossy photo paper, and slide them into your booklet's clear page protectors. —*Gerry Yarrish*

Wise Owl Publications (562) 461-7574; wiseowlmagazines.com.

THINKING BIG
by Gerry Yarrish

Shown here with Susan Valles, the yet-to-be-released BTE Reaction 54 has plenty of wing area that adds to its forgiving slow-speed flight performance.

A new crop of turbine jet trainers

For several years now, turbine-powered jet models have been gaining popularity. The development of the engines, support equipment and control systems in recent years has been nothing less than amazing. Turbines are becoming less expensive, and the onboard electronics have developed to a point where just a push of a single button will make it all go. Just about anyone can operate them correctly and safely. With this ever-increasing plug-and-play sophistication, turbine-powered jets are slowly becoming more accessible to sport fliers. This month, I thought I'd highlight some of the new sport jet turbine trainers that are or will soon become available.

It's a given that to fly jets, especially turbine-powered ones, you must be an experienced pilot. But what has been missing (until now) has been a relatively inexpensive transition model designed to give new jet pilots the time and experience to learn how to operate a turbine jet engine. Several well-known model designers realized this and are now producing down-to-earth trainers. One way these designers have kept the speeds and wing loading down (both good things for trainer aircraft) was by making their models relatively large!

According to the IMAA, giant scale is generally considered to apply to model aircraft with minimum wingspans of 80 inches for monoplanes and 60 inches for multiwing aircraft. Jet aircraft fall under the "140-inch" rule: the combined fuselage length and wingtip to wingtip span, excluding any protrusions, must be at least 140 inches or larger to be considered giant scale. The aircraft in this column fall into the giant-scale class. Let's take a closer look.

REACTION 54

The next kit to come from Bruce Tharpe Engineering (BTE) will be the Reaction 54. This sleek turbine trainer is tentatively set to be available sometime this year. Bruce is shooting for a release date that coincides with the Toledo show, so please wait until April before you start calling him for this one. Bruce says it's his kind of plane—lots of wing area, a thick airfoil, a relatively low top speed and fantastic low-speed handling. Sounds good to me! So far, flight-testing has been a sheer joy!

The Heatwave from Hobby Hangar is a V-tail turbine trainer that's easy to build.

Bob Violett poses with his new KingCat.

KINGCAT

When it comes to the new crop of turbine-trainer aircraft, the top of the food chain would have to be the all-composite KingCat from Bob Violett Models (BVM). This new twin boom performer is big, and it's lightly loaded. Because of its size, the KingCat will allow a lot of new turbine pilots who prefer larger models to ease into the sport. Its excellent speed range allows very slow approaches and landings.

The KingCat comes out of the box 95-percent built. The kit features an all-composite structure that's painted in the molds and available in multiple schemes; all hardware and control linkages; radio component installation mountings for servos, receiver, batteries, etc. (modeler supplies the screws); huge landing flaps; one large canopy hatch for easy equipment access; an all-new, heavy-duty landing gear designed for grass fields; and a large-capacity fuel tank that's close to the CG for minimal trim changes. It's easily transported because it can be broken down into several components. An optional clear canopy and molded cockpit are also available.

WS: 80 in.; **L:** 94 in.; **weight:** 27 lb.; **wing area:** 1,600 sq. in.; **wing loading:** 37 oz./sq. ft.; **recommended engine:** 19- to 35-lb.-thrust class; **flight duration:** 14 min. **Price:** $3,895 (plain white finish)

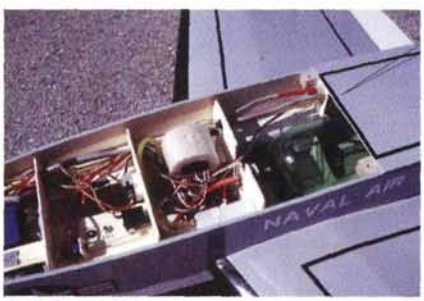
The KingCat's turbine engine sits out in the open between the two tail booms above the center of the wing's trailing edge.

The Reaction 54 has all-wood construction and doesn't have any foam or fiberglass parts. It's designed to use 54mm compressor turbines (hence its name) such as the RAM 500, PST 600, FTE 500T, Wren 54, Mamba and several others. It has retracts, flaps and plenty of room in the nose compartment for all the necessary equipment. Bruce's prototype has several features that you don't see on a lot of many other turbine models. For one, it has a few open rib bays near the wingtips. It uses a MonoKote covering and CA Easy Hinges. Flex cables in a pull-pull linkage setup are used for the rudder and elevator; Bruce has installed an electric nosewheel brake. There's no fixed price yet, but the ballpark figure is in the $400 to $500 range.

WS: 78 in.; **L:** 80 in.; **dry weight:** 15.5 lb.; **wing area:** 1,450 sq. in.; **recommended engine:** 54mm compressor class.

HEATWAVE

Designed by Dave Platt, the Heatwave from Hobby Hangar has a very jet-like appearance that enhances its simplified, all-wood construction. The easy-to-build model will certainly draw attention wherever it goes. The kit comes with precision CNC-machined and laser-cut parts, and it features plug-in wing panels. The scale-like model has retractable trike gear, flaps and a unique split-V tail that forms the mounting platform for the turbine engine. The very large main hatch greatly simplifies equipment access, and with the engine out in the open, there's no fussing around with internal ducting or tailpipes. The prototype is finished with a lightweight iron-on film that further simplifies the build and makes repairs much less of an issue.



With its main hatch cover removed, the Heatwave's radio gear and engine control components are easy to get to.

The turbine sits in the tail of the Heatwave between the two V-tail control surfaces. Engine access is totally unrestricted.

WS: 78 in.; **L:** 77 in.; **wing area:** 1,254 sq. in.; **recommended engine:** 18- to 25-lb.-thrust class. **Price:** $459.99 (plus S&H).

FACET 2300

Designed by Kerry Sterner, the KJ Scaled Designs Facet 2300 is a sport jet/turbine trainer. Quick to build and a pleasure to fly, Kerry's design has large flaps and rugged, fixed landing gear that make it a perfect grass-field flyer. Kerry says the Facet can operate from fields as short as 400 feet. The Facet is designed to be a fast, easy build and uses laser-cut parts. You can add stock balsa from your local hobby shop, or you can order the optional wood pack. The average builder can frame up a model completely in as little as two weekends. The Facet features a 2-piece, plug-in wing for fast field assembly and easy transport. The semi-kit contains 57 laser-cut wood

The Facet 2300 from KJ Scaled Designs has fixed gear for rugged grass-strip performance and features a handy mounting tray for all the internal equipment.

FUNSONIC TURBINE

Exclusively distributed in the U.S. by Robart Mfg., the new FunSonic FS52AS turbine is an AMA-certified engine that can produce 12 pounds of thrust. It weighs only 1½ pounds and is a full auto-start engine; it comes with an electric-starter motor. The power system uses a small onboard propane gas supply to initiate engine start, and then the engine automatically switches over to the main fuel tank that contains kerosene. Fuel consumption is roughly 5½ ounces per minute. Priced at $2,495 for the engine and the complete control system, the FunSonic turbine would make a great engine for any jet that requires 10 to 12 pounds of thrust!

Specs

THRUST: 0.6 to 12 lb.
DIAMETER: 3.2 in. (83mm)
LENGTH: 9.2 in. (235mm)
WEIGHT: 1.5 lb. (complete system: 2.5 lb.)
RPM RANGE: 52,000 to 160,000
FUEL TYPE: Jet-A, K1 kerosene

The new FunSonic FS52AS turbine engine develops 12 pounds of thrust and features auto-start.

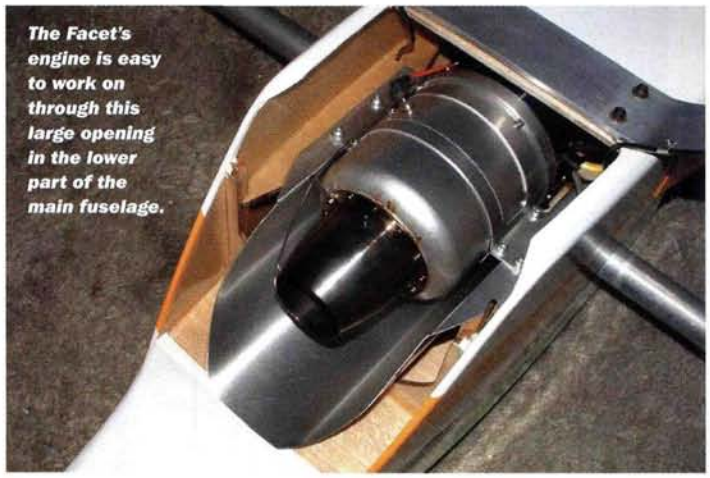
The hardware included with the FunSonic turbine is very complete and includes the fuel pump, drive batteries, gas and fuel filters, mounting brackets, 3mm gas and 4mm fuel lines, connectors, valves and a start checklist.

The FunSonic's startup and control components include the onboard turbine control unit, the handheld startup display unit, a gas tank with T-quick connector, a propane gas solenoid valve, turbine power wire harness, two large data harness leads and an input/output circuit board with small data harness lead.

parts, a custom aluminum main landing gear and an Oleo nose-gear strut, a wing-joiner tube, foam wing-cores, an aluminum heat shield, a 64-ounce main fuel tank, CAD plans, an assembly and flight setup manual and a bill of materials.

A unique design feature of the Facet is that all the turbine electronics and fuel delivery components are mounted on a single, removable tray that greatly simplifies the equipment installation.

All the electronics are installed on this easy-to-remove plywood shelf.



The Facet's engine is easy to work on through this large opening in the lower part of the main fuselage.

WS: 90 in.; **wing area:** 1,210 sq. in.; **dry weight:** 18 to 20 lb.; **wing loading:** 38 oz./sq. ft.; **L:** 70 in.; **fuel capacity:** 118 oz.; **recommended engine:** SimJet 2300 or 1700. **Price:** $389 USD; $599.99 CND. (A 68-inch-wingspan Facet 1200 is also available.)

If you've been on the fence about getting into turbine-powered models, these new trainer aircraft just might be your ticket into the fast lane. Be sure to check with the turbine regulations available from the AMA and get yourself certified for turbine operation. Till next time, fly safe! ✈

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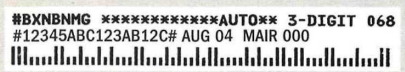

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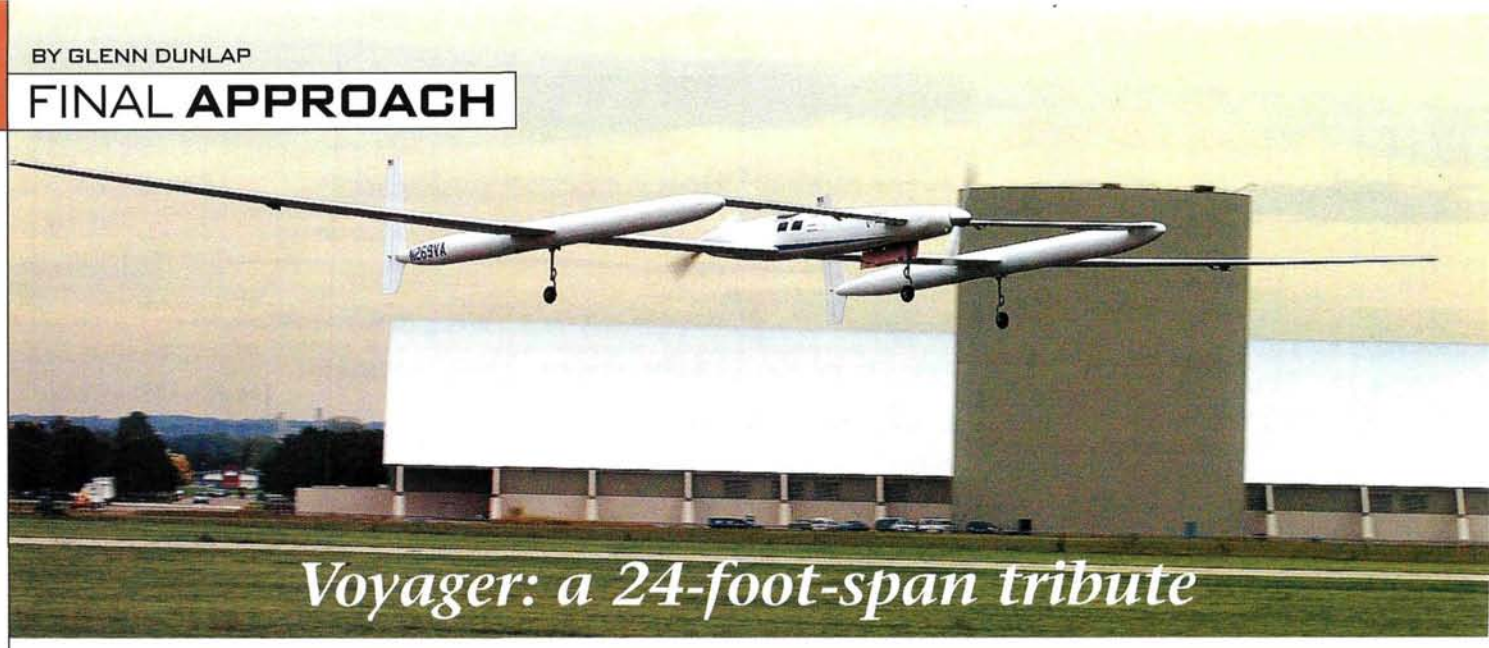
BY GLENN DUNLAP

FINAL APPROACH



Voyager: a 24-foot-span tribute

I first saw the Voyager on a trip to the Smithsonian Institution in the spring of 2000 and was intrigued by the unusual aircraft. In the summer of 2002, the Greater Cincinnati Radio Control Club challenged its members to build a model based on significant aircraft from aviation history to commemorate the 100th anniversary of powered flight. I didn't know how I'd do it, but I volunteered to make a model Voyager. If I had only known the adventure that awaited!

I scoured the Internet, AMA archived files, EAA and the Smithsonian websites and didn't come up with anything usable. I tried to contact Jeana Yeager and Burt Rutan without success, but Dick Rutan sent me a video, a book and a packet of miscellaneous information with some sketches and incomplete dimensions. It was a start!

I took the information and started to plan. I wanted my model Voyager to be made mostly of foam, to use electric power and to have retracts. My original plan had a 12-foot wingspan, but after considering the strength needed for the canards, I went with 24 feet, and this still yields only a 4.5-inch-wide chord! And bigger flies better, right?

Don Stackhouse of DJ Aerotech (who worked on the props for the full-size Voyager) gave me an accelerated course in the fundamentals of aerodynamics, and club member Tom Scott designed and built the spar joiner boxes and the landing-gear supports. Jim Ryan, another club member, helped to select the motor and the battery system. Soaring columnist Mike Garton helped me choose the proper covering materials for the foam wings.

The fuselage is an all-pink-foam shell that covers a plywood crutch that I used to hang everything on. The shell is covered with a layer of 6-ounce fiberglass and epoxy. I used the same technique with the booms. I cut the booms and fuselage in sections at home with a hot wire, and the folks at CompufoamCore.com cut the 14 wing panels. I built the wing in three sections and covered it with Uni-web carbon fiber, two layers of fiberglass cloth and West Systems epoxy. I capped the top and bottom of the spruce spars with unidirectional carbon fiber to form an I-beam. To strengthen the canards, I constructed them with a wrapped carbon-fiber phenolic-tube system in the foam-core. This served as a spar and as an attachment system. I sheeted the canards with 2.9-ounce fused unigraphite (basically, a sheet of carbon fiber) top and bottom and added two layers of fiberglass cloth. Rustoleum paint finished the project.

Judging from the information I have, the model is actually very true to scale and has only slight deviations in the chord and rudder area.

After 10 months of intense building and spending more money than I ever expected, it all came down to one very nervous moment! Voyager slowly built up speed down the runway. When I thought it wouldn't go any faster, it literally leapt off the runway as if it couldn't stay earthbound another moment! It stayed aloft for 3 minutes. It was exhilarating and unbelievable to see this unusual but graceful ship sailing through the silence of the evening. I made two large ovals around the field at about ½ throttle. The elevator was very sensitive, but ailerons and rudder were not; Dick Rutan told me that the full-size Voyager was the same way. I made a final approach, reduced power to ¼ throttle and missed the centerline by only a few feet.

Building this model Voyager was an incredible experience that stretched my knowledge and skills, brought me new friends and was a fitting way to commemorate an incredible aviation achievement. I encourage fellow modelers to take a chance, risk a new limit and, in the words of Eleanor Roosevelt, "... do the very thing you think you cannot do." ✈

SPECIFICATIONS

MODEL: Voyager

BUILDING TIME: 10 mos.

WINGSPAN: 24 ft.

WEIGHT: 32 lb.

WING AREA: 3,000 sq. in.

WING LOADING: 27 oz./sq. ft.

POWER: 2 AstroFlight Cobalt 40s w/Superbox gearbox (3.1:1)

PROPELLERS: Zinger 18x10 pusher and puller

BATTERIES: two, 22-cell CP2400 Ni-Cd packs

RETRACTS: Robart 630 series

PHOTOS BY GLENN DUNLAP